SPECTRAL STUDIES OF Cr I AND Cr II ATOMS

DISSERTATION

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Dedicated to my parents

Certificate

This is to certify that the results presented in the Dissertation entitled "**Spectral studies of Cr I and Cr II atoms**" being submitted by **Mr. Riyaz Ahemad**, Research scholar, Department of Physics, Aligarh Muslim University, Aligarh in partial fulfillment of the requirements for the award of **M. Phil. (Physics)** are based on the work done by the candidate during his M. Phil. programme.

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Chapter 1

Introduction

Spectroscopy is the branch of science dealing with the study of interaction of electromagnetic radiation with matter. The absorption or emission processes are known throughout the electromagnetic spectrum ranging from the gamma ray region to the radio region (NMR). The experimental measurement of radiation frequency gives a value for the change of energy involved from which one may draw conclusion about the set of possible discrete energy levels of the constituent(s) of the matter. The ways in which the measurements of radiation frequency (absorbed or emitted) are made experimentally and energy levels deduced from this comprise the practice of spectroscopy.

The spectra are studied, especially to determine the chemical composition of substances and physical properties of molecules, ions and atoms. From these studies, it gradually became clear that the particular wavelength of light associated with atoms of a given element are characteristic of that element. Therefore, the spectral information must provide clues to the internal structure of the atom.

1.1 Line Spectra

Information concerning the electronic structure of an isolated atom (or ion) can be inferred from a variety of different types of experimental investigations—for example, data on elastic and inelastic scattering of electrons, ions or x-rays by the atom and data on the energies of photoelectrons ejected from the atom. By far the most important source of high-accuracy information, however, comes from the spectroscopic study of light radiated or absorbed by the atom **[1]**.

The spectrum of the light radiated by atoms in an appropriate light source may be examined with the aid of the simple prism spectrograph. Light from the source is focused on a narrow entrance slit that is oriented parallel to the dispersing faces of the prism. The light passing through the slit is dispersed according to wavelength in passing through the prism. For each wavelength of light present, a camera lens forms an image of the slit on a photographic plate; the various images for the different wavelengths are displaced from one another in a direction perpendicular to the length of each slit image. If the source is such (for example, an incandescent solid) as to radiate light of all wavelengths, the photographic plate records a continuous succession of overlapping slit images, and the spectrum is correspondingly known as a continuous spectrum. However, if the light from the source is radiated by a collection of isolated atoms, it is found to consist of a greater or smaller number of isolated wavelengths: if a very narrow spectrograph-slit is used, the spectrum appears on the photographic plate as a set of isolated parallel lines. Such spectra are accordingly referred to as line spectra, to distinguish them from the continuous spectra of solids and the "band" spectra of molecules.

Evidently, the line-image form of observed spectra of atoms is a characteristic of the shape of the entrance slit of the spectrograph. For modern research work, the prism spectrograph has almost entirely been replaced by spectrographs using a diffraction grating as the dispersing element, but the use of a narrow entrance slit still results in line spectrum. For ultra high resolution work, Fabry-Perot and Michelson interferometers may be used; these produce interference fringes in the form of concentric circles rather than straight lines. Even with a grating spectrograph, the instrument is sometimes used without a slit (or, rather, with an extremely wide slit), and the spectrum then appears as a set of (usually overlapping) images of the source, one image for each wavelength present. Nonetheless, because of appearance of the spectrum produced by the classic narrow-slit instrument, each essentially monochromatic wavelength present in the light emitted by an atom is called a spectral line.

1.2 Characteristic spectra of atoms and ions

Each atom or ion emits a line spectrum which is characteristic of that atom or ion. This provides the basis for spectrographic methods of the analysis of the composition of (vaporized) alloys or other mixtures of atoms; indeed, several elements (among them Helium, Rubidium, Cesium, Gallium, Indium and Thallium) were discovered spectroscopically **[1]**.

The spectrum emitted by neutral atoms of a given element is called the first spectrum of that element, and is denoted by the Roman numeral I; the spectrum emitted by singly ionized atoms is called the second spectrum and is denoted by Roman numeral II, etc. The first spectrum is sometimes also called the arc spectrum, because it is one that is most prominent in the spectrum of a low-current d-c arc. The second spectrum is called the (first) spark spectrum because it becomes strong in a high-voltage (low-current) spark.

Obviously the number of different possible line spectra of an element is equal to the atomic number Z, so that there exist the spectra H I; He I, He II; Li I, Li II, Li III, etc. Such high-ionization-stage spectra as Fe XVIII-XXVI, Mo XXXI-XXXIII, and Au LII have been produced in the laboratory, and lines of Fe XXV (helium-like iron) have been seen in spectra of solar flares **[4]**.

1.3 Isoelectronic sequences

A neutral atom and those ions of other elements having the same number of electrons as the atom, comprise an isoelectronic sequence. Note that a negative ion having this number of electrons is a member of the sequence. Spectra of ions of different elements having the same number of electrons N tend to be very similar in general structure, especially for highly ionized atoms. A sequence of ions having fixed N, or the corresponding sequence of spectra, is called an isoelectronic sequence. An isoelectronic sequence is usually denoted by its first (neutral-atom) member; for example, the Ar I sequence consists of Ar I, K II, Ca III, Sc IV, etc. However, if emphasis is on a particular highly ionized member of a sequence, the sequence might be denoted by this member; for example, the Ar I sequence might also be called the Fe IX sequence, and thought of as the sequence Cr VII, Mn VIII, Fe IX, Co X, Ni XI, etc.

Since, every member of such a sequence contains the same number of extra nuclear electrons, the energy structure and the spectral lines arising from members of a sequence show remarkable similarities among themselves. This provides an invaluable means of identifying transitions and checking the accuracy of identifications along the sequence **[2]**.

1.4 Energy levels

The fact that light is radiated by an atom at only certain discrete wavelengths is associated with the fact that the atom can exist only in stationary states having certain discrete values of internal energy E. The existence of such discrete energy states is confirmed by the observation that bombardment of an atom with mono-energetic x-rays produces photoelectrons of only certain discrete kinetic energies, and by the observation that low energy electrons scattered inelastically from an atom at a given angle can lose only certain discrete energies.

The various possible energies of the atom are called energy levels. The lowest possible energy is called the ground level, and each quantum state of the atom having this energy (there may be more than one such state) is called a ground state. All other levels are called excited levels, and the corresponding quantum states are called excited states.

Levels corresponding to tightly bound (inner-shell) electrons can be determined through a study of photoelectrons produced by absorption of x-rays, directly through a study of emission and absorption X-ray spectra or through line absorption spectra using synchrotron radiation as a continuous background source, etc **[1]**.

1.5 Theoretical background.

Emission of light takes place when there is transition of an atom from a state of higher to a state of lower energy— a quantum jump. Likewise absorption takes place by an upward transition that is caused by the action of the fields of the radiation on the atom. We start the consideration of these processes by a somewhat phenomenological method due to Einstein. The argument is independent of special views concerning the electrodynamics of the transition **[3]**.

1.6 Hartree-Fock approximation method

In computational physics, the **Hartree-Fock (HF)** method is an approximate method for the determination of the wavefunction and energy states of a quantum many-body system.

The Hartree-Fock method assumes that the exact N-body wavefunction of the system can be approximated by a single Slater determinant (for fermions) or by a single permanent* (for bosons) of N spin-orbitals. Invoking the variational principle one can derive a set of N coupled equations for the N spin-orbitals. Solution of these equations yields the Hartree-Fock wavefunction and energy of the system, which are approximations of the exact ones **[5]**.

In our laboratory of atomic spectroscopy, HF calculations are performed using R.D. Cowan's atomic structure code. Cowan's code is a Fortran 77 program created at Los Almos by Robert Cowan in 1968 improved later on. This is a set of four programs namely RCN/RCN36, RCN2, RCG and RCE **[1]** calculates atomic structures and spectra.

The RCN/RCN36 program calculates the one electron radial wavefunctions (bound or free) for each of any number of specified electron configurations, using the Hartee-Fock method. The RCN2 code is an interface program that uses the output wavefunctions from RCN to calculate the configuration interaction Coulomb integrals (R^k) between each pair of interacting configurations and the electric dipole (E1) and/or electric quadrupole (E2) radial integrals between each pair of configurations. The RCG code set up energy matrices for each possible value of the total angular momentum J, diagonalizes each matrix to get eigenvalues (energy levels) and eigenvectors. The RCE is basically a least squares fitting program. The basic purpose of RCE is to adjust the value of various theoretical parameters so as to produce computed energy levels in the best possible agreement with experimentally known level values **[1]**.

* In linear algebra, the **permanent** of a matrix is a function of a matrix related to the determinant. The permanent as well as the determinant are polynomials of the entries of the matrix.

REFERENCES

1. R.D. COWAN "The Theory of Atomic Structure and Spectra" University of California press, Berkeley (1981) and Cowan code computer programs.

2. Spectral Study of the Niobium spectra: Nb III, V, VII, Ph.D. thesis, Q.Shujauddin, Department of Physics, Aligarh Muslim University, Aligarh (1982).

3. E. U. Condon and G.H. Shortley, The Theory of Atomic Spectra Cambridge University Press (1953).

4. W.M. Neupert, W. Gates, M. Swartz, and R. Young, Astrophys. J. **149**, L79 (1967).

5. http://en.wikipedia.org/wiki/Hartree-Fock.

Chapter 2

Light sources

2.1 Types of light sources:

Different types of sources are used to generate electromagnetic radiation of desired region. The light sources, or sources of radiant energy, may be classified according to the

(a) method used for exciting radiation,

(b) type of spectrum emitted, or

(c) spectral region to which the source is best adapted (infrared, visible, ultraviolet, or extreme ultraviolet).

The light sources may also be classified in terms of method of excitation; there are four principal categories of sources:

(1) thermal radiators, (2) arc sources, (3) discharge tubes, and (4) spark sources **[2]**.

In addition to the four principal categories mentioned above, there are certain other methods of excitation, such as bombardment by cathode rays or other particle beams or excitation of fluorescence or resonance radiation, that are sometimes useful in spectroscopy.

2.2 General characteristics of light sources

In choosing a source for a particular application, it is desirable to select one that emits radiant energy predominantly in the spectral region to be explored. This selection is frequently difficult to achieve in practice. For example, incandescent lamps are excellent sources for many applications in the visible region, yet they radiate more total energy in the infrared than in the visible. The greater the atomic or molecular energy transitions involved in the excitation, the shorter the wavelength region in which the radiant energy may be expected to predominate. Thus thermal-emission sources are mainly useful for the infrared and visible regions, while arcs for the visible and near ultraviolet, and discharge tubes and sparks for the visible, ultraviolet, and extreme ultraviolet regions.

Sources emitting continuous spectra are particularly useful in making absorption studies measurements. Those emitting line spectra are useful in studying atomic structure and in qualitative and quantitative emission spectrum analysis **[3]**. The principal light sources and their general spectral characteristics are given in Table 2.1.

Table 2.1 General Spectral Characteristics of principal types of sources

Source	Principal spectral region	Type of spectrum	Principal applications
Blackbodies	Infrared, visible, near ultraviolet	Continuous	Radiation standard
Incandescent lamps	Infrared, visible, near ultraviolet	Continuous	Absorption spectrophotometer secondary radiation standards
Metallic arcs with incandescent electrodes	Infrared, visible, near ultraviolet	Continuous with lines superposed	Absorption spectrophotometry
Low temperature thermal radiators	Infrared, visible	Continuous	Infrared Spectroscopy
Open Carbon arcs and metallic arcs	Infrared, visible, ultraviolet	Line with more or less continuous background	Qualitative and quantitative spectrum analysis, wavelength standard
Mercury arcs	Visible, ultraviolet	Line with more or less continuous background	Excitation of Raman effect and fluorescence; absorption spectrophotometry
Discharge tubes	Visible, ultraviolet	Line, band, or continuous, depending on source	Absorption spectrophotometry; spectroscopy of extreme ultraviolet; secondary wavelength standards.
Sparks	Visible, ultraviolet, extreme UV	Line	Qualitative and quantitative spectrum analysis; absorption spectrophotometry spectroscopy of extreme ultraviolet; secondary wavelength standards.

2.3 Continuous sources

Sources giving continuous spectra are called continuous sources. Continuous radiation sources are used to make absorption studies. Thermal radiators emit radiation as a result of heating of the radiating surface, like a current of electricity heats a metal filament to incandescence. The Tungsten incandensces lamp is a good source of continuous radiation in visible region. Some continuous sources are given below:

1. Hydrogen glow discharge
2. Rare gas continua
3. Lyman continuum
4. Synchrotron radiation
5. Bremsstrahlung radiation

2.4 Line source and arc

Line source:

Sources of discontinuous spectra, almost without exception, are atoms or molecules in a gaseous or vapour state that have stored up excess energy in some manner and then radiate it as luminous energy. Sources differ in the method by which energy is supplied to the atoms and in the amount that can be absorbed before radiation. Atoms or molecules may receive energy by absorption of radiations, by transforming kinetic energy from inelastic collisions with electrons or atoms, by taking energy excitation from other atoms or molecules, which have absorbed energy, or by thermal excitation, which is usually a combination of other types.

In the present work we will deal with emission spectra. Many types of emission sources do exist nowadays, to mention a few types are:

1. Cold cathode discharge

2. Positive column

3. Hollow cathode

4. Arc discharge

5. Microwave and radiofrequency discharge

6. Lasers

The electromagnetic spectrum has been divided in various regions in accordance with the types of instruments available to produce and detect the waves of various wavelengths.

Arc source:

The arc is suitable to produce different types of spectrum. Continuous, line and band spectra of different substances can be recorded using arc. Arc sources emit radiation as a result of the maintenance of a comparatively low voltage ionic electric discharge between suitable electrodes, under conditions in which the material of the electrodes is evaporated into the arc stream and provides a large proposition of the conducting and radiation emitting ions. The distinction between arc, spark, and discharge excitation is often only approximate. Thus many Carbon arcs depend for their emission primarily on the heating of the tips of the Carbons to incandescence as a result of bombardment by the ion stream. Again, when spark sources are operated at progressively higher current densities, they begin to partake more and more of the characteristics of arcs.

The continuous spectra arise from thermal radiation or nonquantized atomic or molecular energy transitions (dissociation spectra, for example), line spectra arise from atomic energy transitions, whereas band spectra arise from molecular energy transitions; and all these emission mechanism coexist to some extent in almost every source.

2.5 Condensed spark source

The electric spark is an electrical discharge across a gap separating two electrodes between which a high potential difference exists. The potential gradient necessary to initiate such a discharge depends on the gas pressure in the gap, the ionization potential of the gas, the shape of the electrodes, and other factors. For sharply pointed electrodes in air at atmospheric pressure the required gradient is about 12,000 volts/cm.

Cold emission of electrons from the cathode as a result of the high potential gradient plays an important part in starting the discharge. In this respect, sparks differ from arcs, in which thermionic emission accounts primarily for contribution of electrons to the discharge stream. After breakdown occurs, an oscillatory discharge takes place, the frequency and duration of which depends upon the constants of the electrical circuit. Once the train of succeeding oscillations and sparks has died out, the gap remains quiescent until the potential gradient has been built up again to the point at which a disruptive discharge occurs. During the oscillatory discharge, electrode material enters the discharge stream as a result of ionic bombardment of the cathode. This effect, again, distinguishes sparks from arcs in which vaporization by heat is largely responsible for the entry of electrode material into the arc stream.

As sparks are operated at higher current densities and higher electrode temperatures, they begin to behave more and more like arcs [1]. Indeed, under suitable circumstances the transition to an arc discharge may be complete. Spark spectra show the emission lines of singly and multiply ionized atoms in addition to those of neutral atoms which are characteristic of arc spectra. The emission lines of atoms of the electrode material normally predominate, in terms of total radiant emission, over those of any gasses present in the gap, and the latter may be suppressed almost entirely by use of a series inductance **[4]**.

2.6 The spark in air and other gases

For spectroscopic use, it is convenient to employ electrodes about 3 to 4 mm in diameter with wedge-shaped opposing ends. The electrodes are mounted with the formed edges parallel to each other and to the optical axis of the spectrograph, so that wandering of the spark along the edges does not displace it laterally with respect to the axis. The gap between electrodes may be from 2 to 8 mm.

A spark of these specifications may be operated from an induction coil ("spark" coil) but is much more convenient to use with a high-voltage transformer, the primary of which is supplied with power from a 110- or 220- volt AC line. The transformer should be rated at 0.25 to 1.0 KVA and should develop a secondary voltage of at least 10,000 and preferably 15,000 or 20,000 volts.

If a spark is operated directly from a spark coil or transformer, the capacitance of the circuit is insufficient to permit appreciable storage of electrical energy at the discharge potential. Under this circumstance, discharges occur quite frequently, the spark is "thin" and comparatively nonluminous, and the radiance is low, being primarily from emission by atoms of the gas in the gap rather than from those of the electrode material.

If, however, a Capacitor of appropriate value is connected in parallel with the spark gap, the energy dissipated during each oscillatory discharge is greater, and appreciable quantities of electrode material appear in the gap and contribute to the radiant emission. Although the discharges occur less often (and with lower oscillation frequency), they are of so much greater radiance that the integrated radiation during a given period of time is considerably large. It is customary, therefore, to use a capacitor in the circuit so as to obtain a "hot" bright spark in which the spark lines of the electrode material predominate.

Increasing the value of capacitor augments the brightness of each disruptive discharge. Obviously, however, the capacitance cannot be increased indefinitely with any transformer of given power rating and a circuit of a given resistance, ultimately a capacitance will be reached which is so great that the transformer cannot charge it to a potential sufficient to cause breakdown of the spark gap within the time of a half cycle. Then the condenser will be simply charged with opposite polarities during succeeding half cycles, without any disruptive sparks taking place.

The introduction of an induction coil in the oscillatory circuit, which reduces the frequency of oscillation since $f=1/(2\pi\sqrt{LC})$, tends to reduce the intensity of emission lines arising from the atmosphere in which the spark operates, and gives rise to a hotter spark. Usual values of the self-inductance L of the coil range from some 15 micro-henry to a few milli-henry **[2]**.

2.7 Condensed spark source used in experimental setup

We have designed a d.c. spark source by using a L-C circuit at *Spectroscopy laboratory*, Department of Physics, A.M.U., Aligarh. The main components of this spark source are high voltage power supply, inductor coil, capacitor and electrodes.

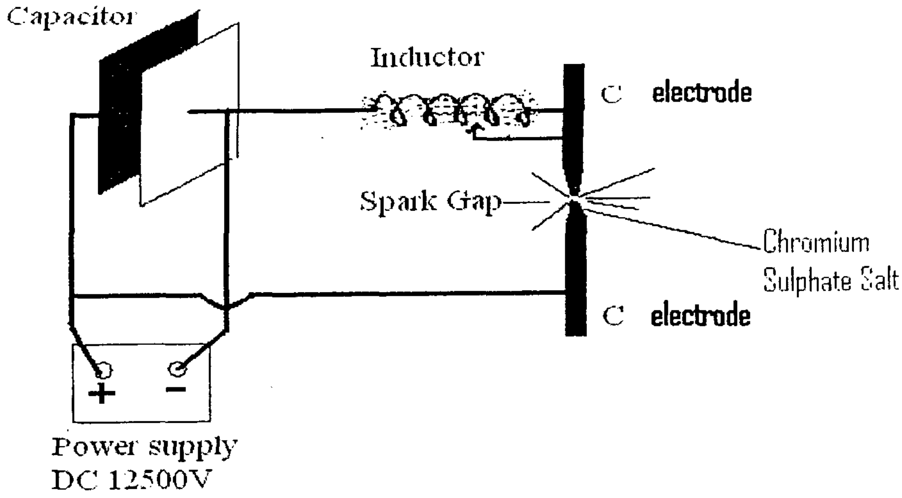

Fig. 2.1: Simple spark source diagram.

The specifications of condensed spark source are: The power supply of variable d.c. output up to 12500 V. The Inductor coil of 6 turns with 20 SWG Copper wire was wound on a 4.5 inch in diameter cylindrical wooden block. The separation between the turns of coil was more than two centimetre. One end of coil is connected to the Capacitor and the other end is so chosen to vary the number of turns. This coil used to provide necessary current density was connected across a capacitor and electrodes as shown in Fig. 2.1. The inductance can be purposefully introduced in series with the source to select unknown spectral lines since radiation from the higher stages of ionized atoms disappears first as series inductor is increased [4]. A very low inductance leads to production of radiation from a very high stage of ionization.

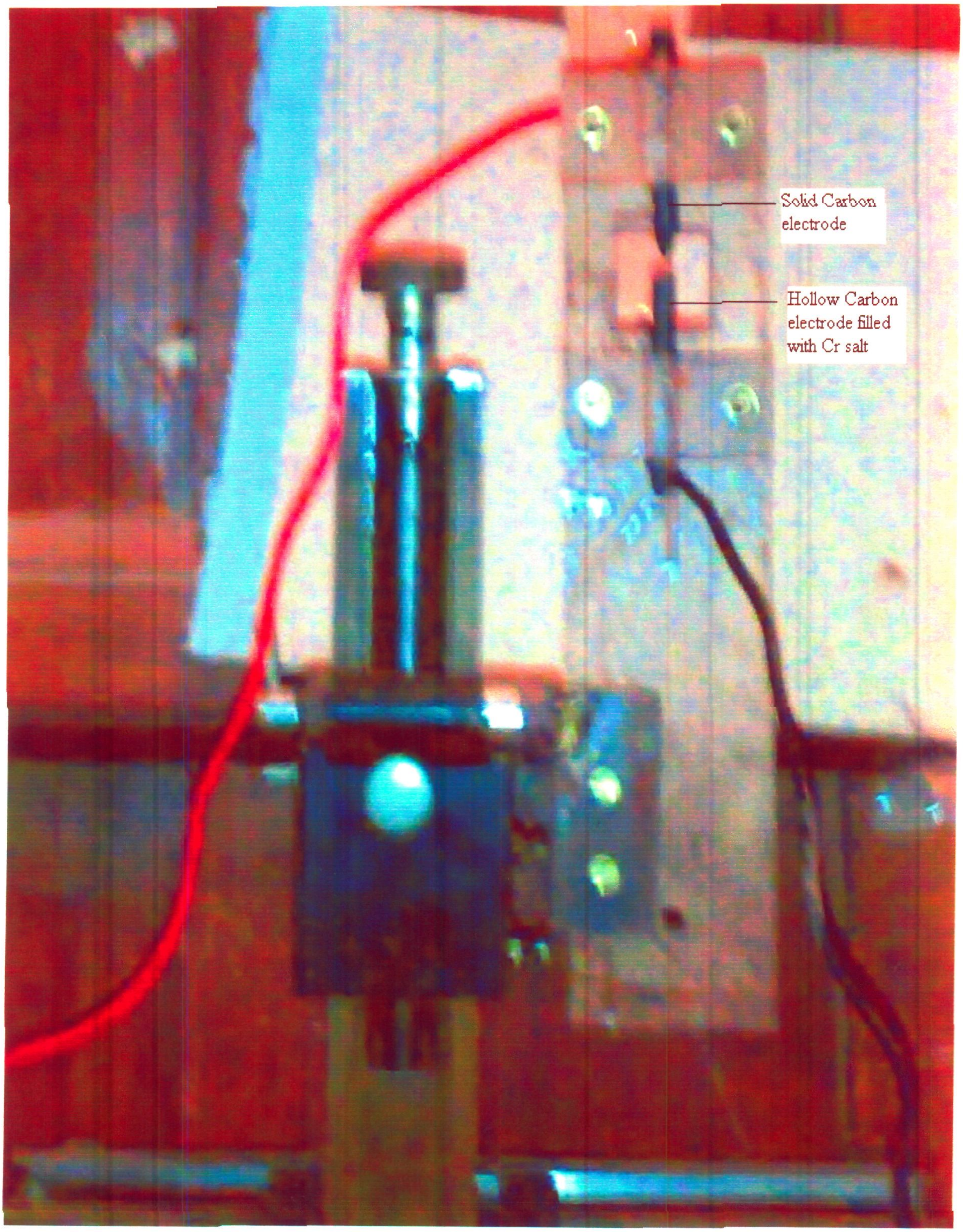

Fig. 2.2: Carbon electrodes mount

The two carbon electrodes were mounted on a thick perspex strip with a big through hole in front of the gap between the two electrodes. This perspex strip is fixed on an old traveling microscope slide to get horizontal as well as vertical alignment of spark.(fig. 2.2).The hallow electrode (anode) is filled with homogeneously mixed mixture of 30% Carbon powder and 70% Chromium Sulphate salt. The gap between two electrodes was kept fixed at 2 mm to produce the desired sparks.

REFERENCES

1. R.A. Sawyer, "Experimental spectroscopy", Dover publications, inc., New York (1963).
2. G.R. Harrison, "Practical spectroscopy", Prentice-Hall, inc., Englewood Cliffs, N.J. (1948).
3. Samson, James A.R. "Techniques of vacuum ultra violet spectroscopy" N.Y., John Wiley (1967).
4. R.C. Gibbs, A.M. Vieweg and C.W. Gartlein, Physical Review, **34**, 406 (1929).

Chapter 3

Spectrograph

A spectrograph is an instrument for producing a spectrogram i.e. a photographic image of the spectrum. The spectrograph [2] consists of the following three parts

1. Slit and collimator.
2. Dispersing/diffracting element.
3. Plate holder.

3.1 Normal incidence grating spectrograph

The principle of a normal incidence spectrograph assembly is shown in fig 3.1.When the angle of incidence α is less than approximately 10°, the radiation is considered to be directed at normal incidence to the grating. For α less than 10°, there is very little astigmatism and essentially no change in the reflectance, hence efficiency of the grating. The actual angle of incidence, then, is dictated by the physical problem of mounting the photographic plate holder and light source. The inside spectrum is normally used either in its first or higher orders since there is actually a loss in resolving power as β increases. There is also a considerable saving in space when the inside spectrum is used [1]. The reflecting power of grating surface is important for determining range in vacuum ultraviolet when using in Normal Incidence mode.

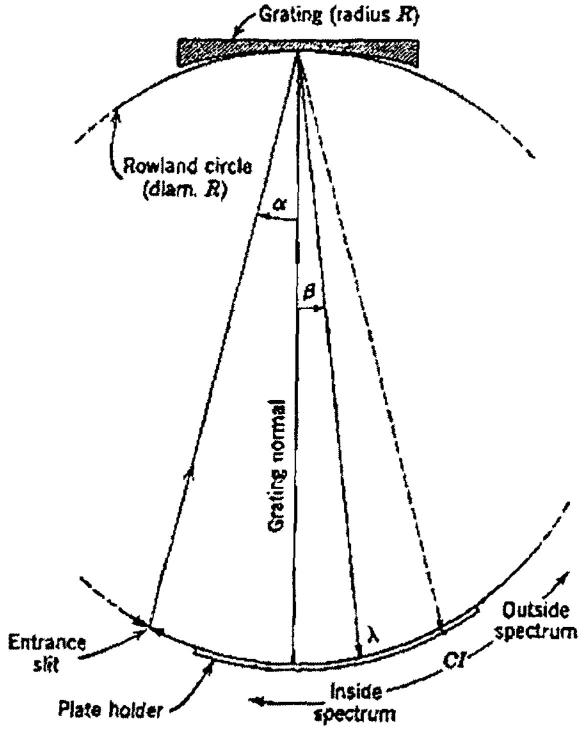

Fig. 3.1 **Optical layout of a basic spectrograph.**

At wavelength λ > 1000 Å, aluminum is the best reflector whereas below that wavelength platinum is superior to aluminum. Grating ruled on glass without subsequent coating by metallic films are often used in this region. Glass has the particular advantage of not tarnishing and of being cleaned easily if it becomes coated with surface films. Normal incidence gratings are usually ruled with 15,000 to 60,000 lines to the inch. The rulings are usually very similar to those used for longer wave ultraviolet and visible regions of spectrum.

3.2 Concave grating

A plane grating requires the use of lenses and mirrors to collimate and to focus the incident and emergent light. Existence of concave grating [2] reduces the use of slit, plane grating and photographic plate. Also, the problem of chromatic aberration vanishes, but astigmatism is exception. Rowland showed that the rulings should be so spaced on the spherical surface as to be equidistant on the chord of the circular arc i.e., spherical blank is held fixed and is ruled as a plane grating with equal relative displacement of

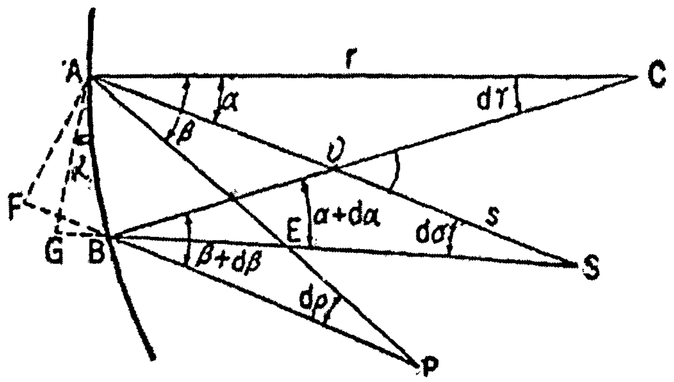

Fig. 3.2: Diffraction by concave grating

ruling diamond and surface for each stroke. The slit, grating and plate holder all lie on a circle whose diameter is equal to the radius of curvature of concave grating—*Rowland Circle*. The grating does not fit this circle but is tangent to it at one point. The grating is in the plane on Rowland circle.

AB→ section of concave grating

A & B→ two consecutive rulings and the distance AB= d, the grating space

$C \rightarrow$ centre of curvature of grating surface

$S \rightarrow$ source of light

SA & SB$\rightarrow$ light rays of wavelength λ at angles α and $\alpha+d\alpha$, after diffraction from the grating at angles β and $\beta+d\beta$ are focused at P. Angle subtended at C,S and P by AB are $d\gamma$, $d\sigma$ and $d\rho$ respectively. SB extended to G such that

$$SG = SA \qquad \text{.........(i)}$$

PB extended to F such that $PF=PA$ ....(ii)

The requirement of the rays SA and SB to reinforce each other on reuniting at P is that optical path should differ by integral multiple of wavelengths.

$$n\lambda = (SA + AP) - (SB + BP)$$

$$= (SG + PF) - (SB + BP) \qquad \text{......from eqn.(i) \& (ii)}$$

$$= SG - SB + PF - BP$$

$$= BG + BF$$

$$= AB \sin\alpha + AB \sin\beta$$

$$= AB (\sin\alpha + \sin\beta)$$

$$= d (\sin\alpha + \sin\beta) \qquad \text{........(iii)}$$

Therefore, concave grating obeys the same equation for position of diffracted images as that obeys by plane grating.

For exterior angles,

(I) $\alpha + d\gamma = d\sigma + \alpha + d\alpha$

$\Rightarrow d\alpha = d\gamma - d\sigma$

(II) $\beta + d\gamma = \beta + d\beta + d\rho$

$\Rightarrow d\beta = d\gamma - d\rho$

Also, $d\gamma = \dfrac{d}{r}$

$$d\sigma = \frac{d}{s}\cos\alpha$$

$$d\rho = \frac{d}{t}\cos\beta$$

From equation (iii) on differentiating

$$0 = d\,(\cos\alpha\, d\alpha + \cos\beta\, d\beta)$$

$$\Rightarrow \cos\alpha\, d\alpha + \cos\beta\, d\beta = 0$$

$$\Rightarrow \cos\alpha\,(d\gamma - d\sigma) + \cos\beta\,(d\gamma - d\rho) = 0$$

$$\Rightarrow \cos\alpha\left[\frac{d}{r} - \frac{d}{s}\cos\alpha\right] + \cos\beta\left[\frac{d}{r} - \frac{d}{t}\cos\beta\right] = 0$$

$$\Rightarrow \frac{\cos\alpha}{r} - \frac{\cos^2\alpha}{s} + \frac{\cos\beta}{r} - \frac{\cos^2\beta}{t} = 0$$

The expression in bracket must be zero for all values of α and β, then

$$\Rightarrow \frac{d}{r} - \frac{d}{s}\cos\alpha = 0$$

$$\Rightarrow s = r\cos\alpha$$

And, $\frac{d}{r} - \frac{d}{t}\cos\beta = 0$

$$\Rightarrow t = r\cos\beta$$

These are polar coordinates for a circle such that points S and P are on Rowland circle of diameter r i.e. radius of curvature of grating **[2]**.

3.3 Astigmatism of concave grating

The concave grating introduces in the spectral line image, the defects of the concave mirror mainly astigmatism. The theory of astigmatism of the concave grating was first proposed by C.R. Runge. Due to astigmatism, a point on slit is viewed as a line whose width z is given by

$z = (\sin^2\beta + \sin\alpha \tan\alpha \cos\beta) .p$

$= k.p$

p→length of ruled lines on grating

k increases rapidly with α and may be greater than unity for large values of α.

As a result of astigmatism the spectral line formed by a grating is made up of a series of overlapping astigmatic line images. As a matter of fact, it is necessary that the slit should be closely parallel to the rulings on the grating such that these astigmatic line images should superimpose to produce sharp spectral lines **[2]**.

Furthermore, to obtain the maximum intensity of line, a long length of slit should be illuminated. Actually, the brightness of the image will increase with slit length until slit length is

$$p.[\frac{\sin^2\beta \cos\alpha}{\cos\beta} + \sin^2\alpha]$$

3.4 The Rowland mounting

The oldest concave grating mounting was constructed by Rowland which requires that the slit, grating and plate holder should all be on the Rowland circle. The grating and the plate holder are fastened on the opposite ends of a long, rigid bar so that the distance between the grating centre and the middle point of the plate holder is equal to the radius of curvature while the plate holder has the curvature of the Rowland circle with a radius R/2.

It can easily be observed that the centre of the grating, the slit and the plate is located on an exact circle, since the right angle whose sides go through the grating and the plate holder centre is always inscribed in the circle whose radius is the diameter of the Rowland circle [2].

The plates cover a range of about 10° or 15° on both sides of the normal to the grating, a range which exhibits a nearly constant and linear dispersion, showing only a slight increase in dispersion for increasing angles β and $-\beta$.

The grating must be leveled so that the normal to the centre of the blank passes through the plane that is normal to the median line of the plate holder, and must be

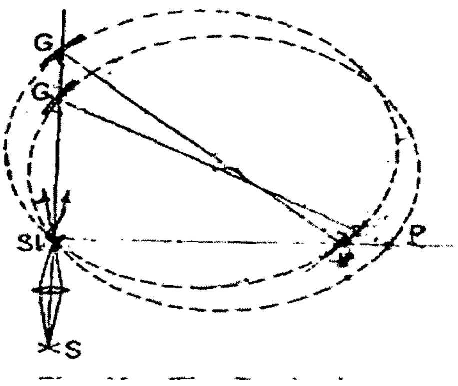

Fig. 3.3: The Rowland mounting of the concave grating

rotated until the grating lines are exactly normal to this plane. The slit must be centered accurately on this plane, located precisely on the Rowland circle determined by the grating radius, and rotated in its own plane until it is accurately parallel to the grating rulings. The photographic plate must be fitted carefully to the Rowland circle and set normal to the plane of this circle.

3.5 Dispersion of spectrum on the Rowland circle

The general relation of the linear dispersion for the concave grating [3] may also be determined. Since focal curve is a circle, the angle γ is determined by β. In the isosceles ΔOM_RB

$$\llcorner\beta = \llcorner\gamma$$

M_R is the centre of Rowland circle.

$OB = r' = r\cos\beta$

Equation for dispersion $\dfrac{dl}{d\lambda} = \dfrac{nr'}{d\cos\beta\,\cos\alpha} = \dfrac{nr}{d\cos\gamma}$

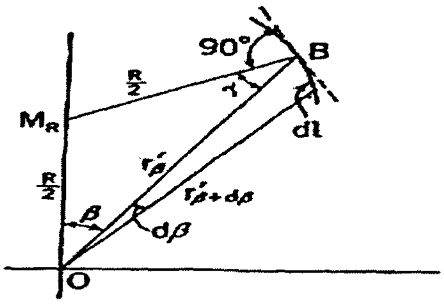

Fig. 3.4: Relation between linear and angular dispersion of the Rowland circle

This indicates that dispersion is dependent of angle β. Any wavelength imaged at an angle β by concave grating with particular values of d and r will have a dispersion that is a simple multiple of the order m. The dispersion increases rapidly as grazing emergence ($\beta \rightarrow 90^\circ$) is approached. The increase occurs slowly and independently of α, which restricts the region of working around the normal of the concave grating for photographs.

Using cosine series

$$\cos\beta = 1 - \frac{\beta^2}{2} + \frac{\beta^4}{24} - .....$$

Then, $$\frac{dl}{d\lambda} = \frac{nr}{d}\left(1 + \frac{1}{2\beta^2}\right)$$

when only the first two members are considered **[2]**.

3.6 Thirty five feet grating spectrograph

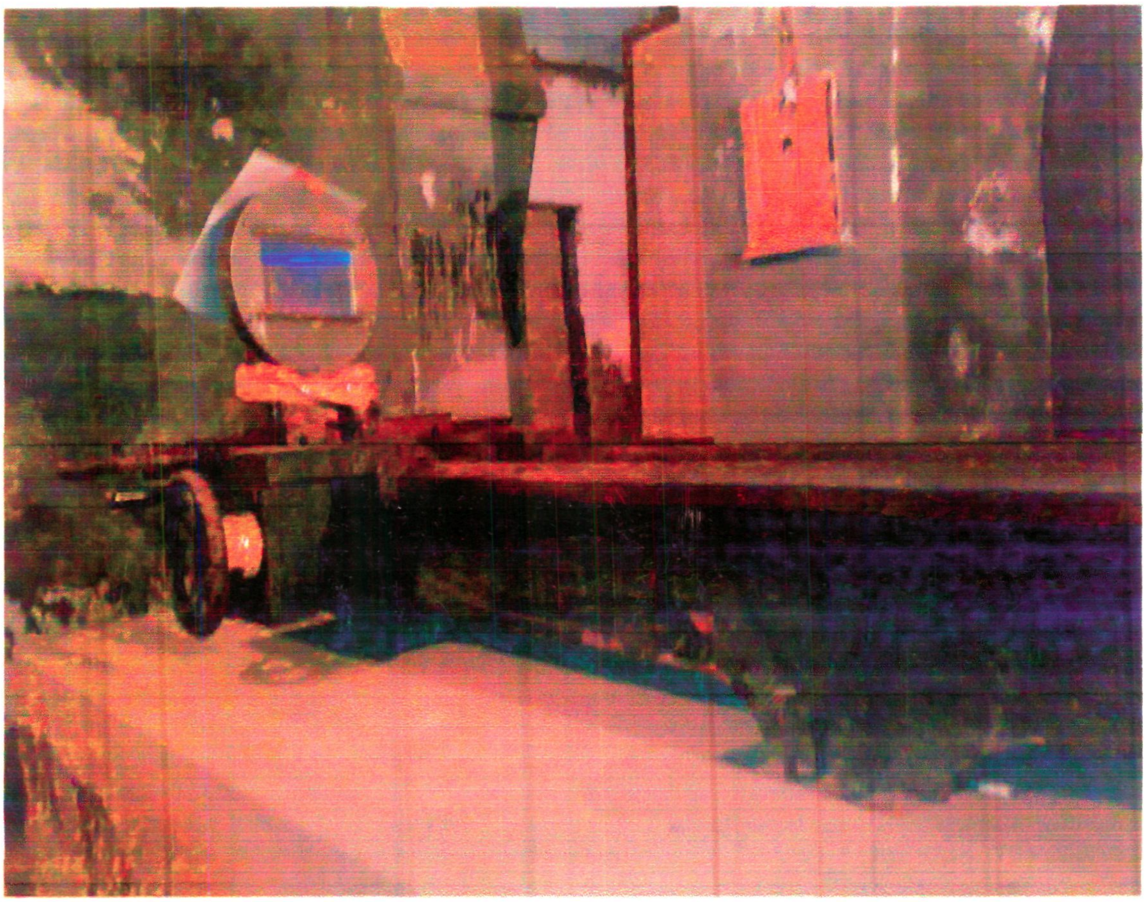

Fig. 3.5 The Grating used in experiment

The 35 feet grating spectrograph of spectroscopy laboratory of Dept. of Physics, A.M.U., Aligarh has a concave grating of 30000 lines per inch. The ruled lines of gratings are at right angle to the Rowland plane. The grating mount rest on a Lathe machine's bed. The bed is fixed on a heavy concrete slab which is isolated from the surrounding with dry sand fillings and rests on lead plates. These arrangements make it completely vibration free. The Lathe machine bed provides the grating mount X and Y displacements.

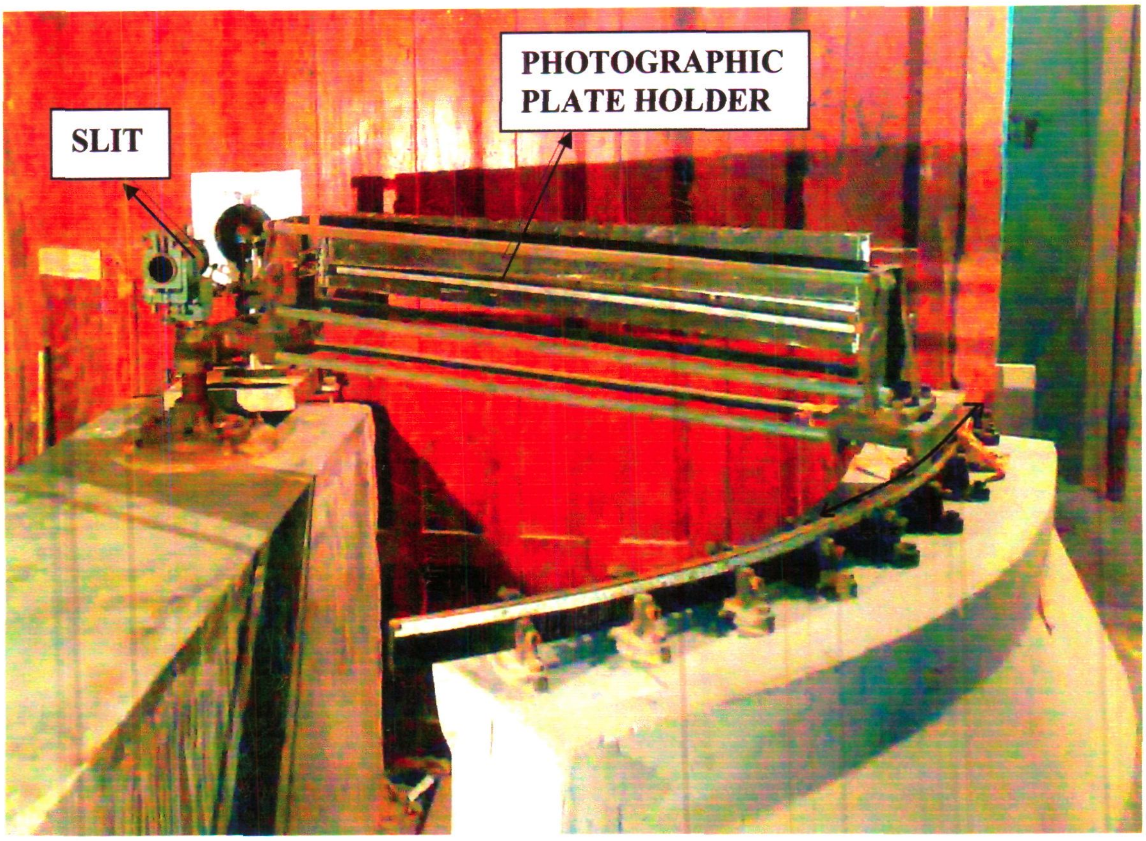

Fig. 3.6: Slit and photographic plate holder

The grating mount also rotates about its own axis (Fig. 3.5). The slit and photographic film holder are also mounted on vibration free concrete slab. The photographic film holder can be rotated on an axis to get a better slit image (Fig 3.6).

The grating mounting is Eagle type which is very compact. The spectrograph axis forms a chord of Rowland circle with grating and plate holder at its ends. The Eagle mounting employs auto collimation (Fig 3.7). The alignment and recording of spectrum on this spectrograph is described in Chapter 4.

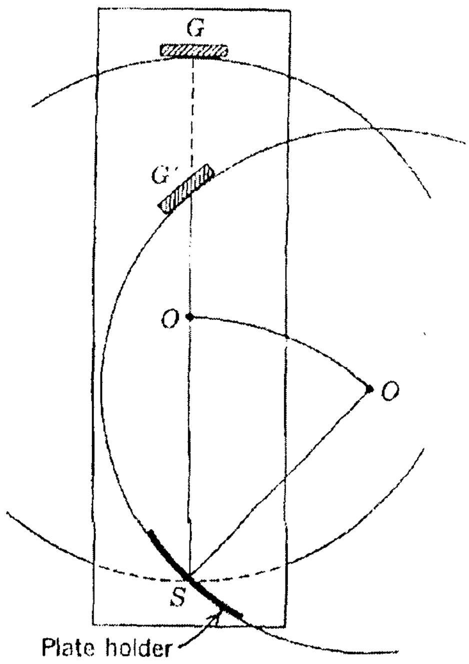

Fig 3.7: The Eagle mounting of Concave grating

REFERENCES

1. Samson, James A.R. "Techniques of vacuum ultra violet spectroscopy" New York, John Wiley (1967).
2. R.A. Sawyer, Experimental Spectroscopy, Prentice-Hall,Inc., New York (1951).
3. K.M. Lal, Ph.D. Thesis, Department of Physics, Aligarh Muslim University, Aligarh (1968).

Chapter 4

Recording of the spectrum and measurements of wavelengths

The spark source developed in our laboratory as described in section 2.1 of this thesis was used to record the spectra of Chromium atoms (Cr I and Cr II) from 4800Å to 5500Å region on 35 ft concave grating spectrograph.

4.1 Alignment of spectrograph with standard Mercury source:

To align the spectrograph, a commercially available Mercury lamp was used. It has a strong green line at 5460 Å. The width and intensity of this line can easily be watched on a glass plate placed in place of photographic plate. To achieve a well defined image of this line, first we vary the position of the grating [2] by moving it along the spectrograph axis. On getting a satisfactory image on the glass plate, we rotate the photographic film holder around its axis to obtain a better image. At last the slit width is varied to get the best image of this line. Finally a spectrum of standard Mercury source has to be recorded to get well defined lines on the whole plate. If it comes satisfactory, the alignment is complete otherwise one has to repeat the alignment procedure.

4.2 Alignment of spectrograph with spark

A converging glass lens was placed in between the slit and the spark source. The lens focuses the spark and also acts as ultraviolet filter. The spark electrodes fixed with a traveling microscope slides (fig 2.2) provide us horizontal as well as vertical alignment of the spark spot. The image of spark specially its intensity can be seen on glass plate as described in the preceding section. The alignment of the spark is done until we get the maximum intensity across the glass plate.

4.3 Loading of photographic film on camera:

We cut the strip of photographic film of the same size as the groove of the plate holder to place the film. The size of the plate holder is approximately 1 metre. Observe the glaze of the photographic film near the recording camera in the dark room and then film holder is placed in the photographic plate holder (Fig. 3.6).

4.4 Recording of the spectrum

The spectrograph has been aligned as described in section 4.1 and 4.2. The Copper arc spectrum and purely Carbon arc spectrum is recorded on the same film [ILFORD 400ASA] by choosing their different heights [Figure 4.2]. The exposure time for Carbon spark spectrum was kept two and half hours. Chromium Sulphate mixed with carbon powder is filled in hollow Carbon electrode to record the Chromium spark spectrum [Figure 4.1]. The exposure time and spark voltage was kept same as that of pure Carbon spark spectrum.

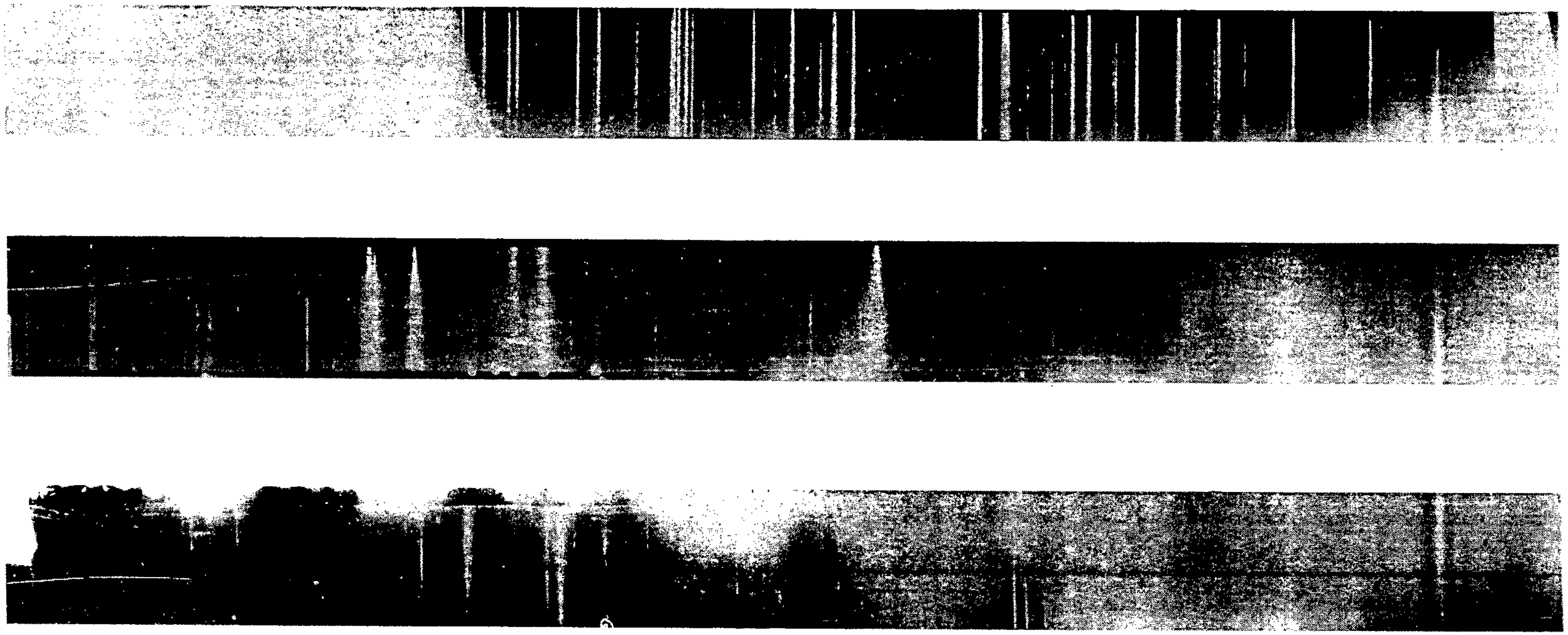

Fig 4.1-Spectrum of Chromium

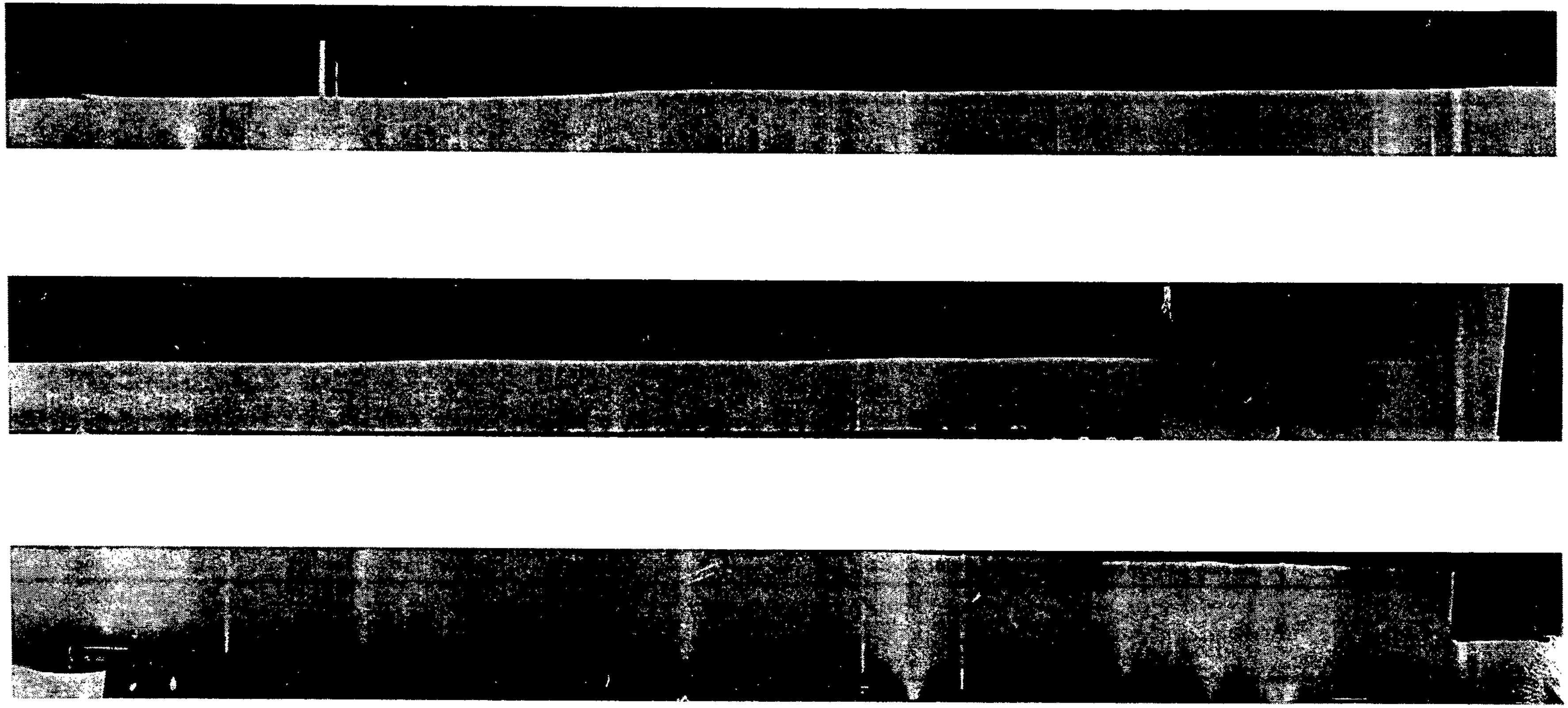

Fig 4.2 Spectrum of Copper and Carbon

4.5 Development and fixing of the exposed film

The recorded spectrum on photographic film is opened in the dark room without any light and put into developer for 8 minutes. After rinsing into developer solution, the film is washed by fresh water and put into the fixer for 3 minutes. Again it is washed with fresh water.

4.6 Measurements of the wavelengths

First, the Standard green lines [4] 5105.551A, 5153.226A, 5218.170A and 5220.041A of Cu I can be identified on Copper and Carbon spectrum recorded on the same film. The carbon too have some lines 5380.34, 5052.17 and 4932.05 which could be easily find out These lines are also observed with Chromium spectrum. The position of each spectral line on the plate was measured using Zeiss Abbe comparator shown in Fig. 4.3 at the Aligarh Muslim University laboratory. This comparator can measure the line position of sharp lines up to ±0.0005 mm and a few times larger for wide lines and asymmetric lines [1]. The wavelength of the lines corresponding to the measurement are calculated by a computer program called MOSFIT which was developed by G.J. VAN HET HOF of a polynomial fit of the impurity lines called internal standards [3]. The observed lines are given in Table 4.1.

Table 4.1 Observed lines of Chromium

Observed wavelength in air(Å)	Ions affiliation
5480.4999	Cr I
5447.4491	Cr II
5446.7210	Cr II
5440.1396	Cr II
5436.8762	Cr II
5425.5641	Cr II
5423.1410	Cr I
5420.8299	Cr II
5419.3607	Cr II
5409.7618	Cr I
5405.1824	Cr I
5400.6908	Cr I
5390.3856	Cr I
5387.5846	Cr I
5386.9502	Cr I
5380.3400	C I
5363.8840	Cr II
5362.9239	Cr I
5357.4124	Cr II
5354.3127	Cr I
5348.3317	Cr I
5345.8965	Cr I
5342.5177	Cr II
5333.7785	Cr II
5329.1272	Cr I
5328.3781	Cr I
5308.7233	Cr I
5300.7005	Cr I
5298.2768	Cr I
5288.3880	Cr II
5265.7573	Cr I
5264.1517	Cr I
5208.4094	Cr I
5206.0360	Cr I
5204.5180	Cr I
5198.7173	Cr II
5196.6058	Cr I
5183.4065	Cr II
5181.2330	Cr II
5171.3139	Cr II
5154.9225	Cr I
5144.6313	Cr I
5138.5621	Cr II

5102.5278	Cr I
5096.7943	Cr I
5087.9860	Cr I
5085.6106	Cr I
5076.2061	Cr II
5074.5776	Cr I
5068.3949	Cr I
5067.7185	Cr I
5063.9741	Cr I
5059.6001	Cr II
5052.1700	C I
5038.5463	Cr I
5034.2570	Cr I
5032.5555	Cr I
5019.0953	Cr I
5013.3176	Cr I
5001.1463	Cr I
4990.3886	Cr II
4962.2909	Cr I
4959.8062	Cr II
4956.5914	Cr I
4951.1998	Cr I
4932.0400	C I

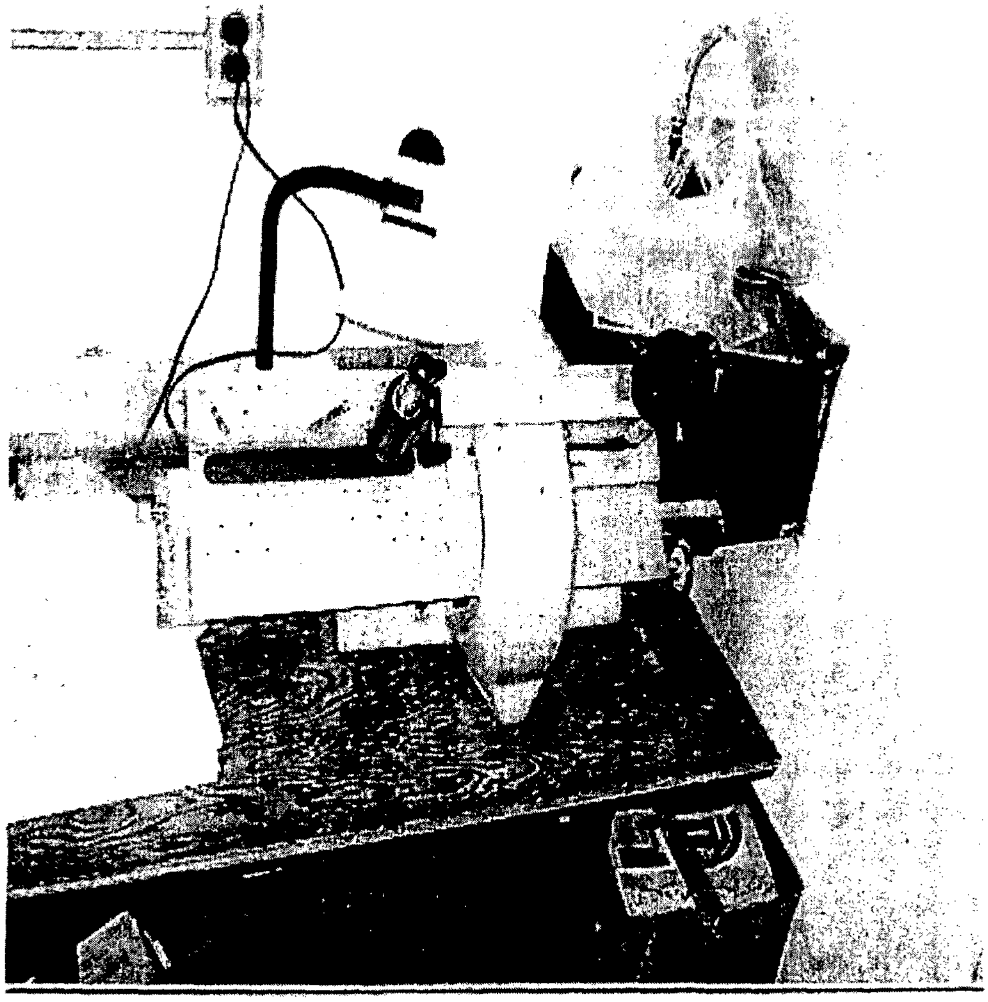

Fig. 4.3: The Zeiss Abbe comparator used for measurement of wavelength positions

REFERENCES

1. Sawyer, Ralph A.: Experimental spectroscopy" 2nd ed. New York, Prentice–Hall (1951).

2. Samson, James A.R. "Techniques of vacuum ultra violet spectroscopy" N.Y., John Wiley (1967).

3. J.G VAN HET HOF, A computer program "Mosfit2" for wavelength calibration using a polynomial fit.

4. www.physics.nist.gov/PhysRefData/ASD/index.html

Chapter 5

Results and discussion

5.1 Spectra

The spectrum was recorded in the region (4800-5600 Å) on 35 feet grating spectrograph at Department of Physics A.M.U., Aligarh. The spectrograph was aligned as discussed earlier in the section 4.1 and 4.2. A detail description of the spectrograph is given in section 3.6. The sample for recording of spectra was prepared by mixing Carbon powder and Chromium Sulphate in the ratio of 3:7. The spark source was designed in our laboratory [section 2.7].The spectrum was recorded on photographic 36 mm film. In all some 66 lines in the wavelength range covered i.e. 4800-5500Å, were observed to belong to the Chromium element besides impurity lines of Carbon which served as references to evaluate the wavelengths of the spectral lines observed on the spectrogram. The intensity of the lines observed are the visual estimates of their relative blackening on the film. The ionization separation was done on the basis of distinct characteristics exhibited by individual lines like their sharpness, length , pattern of blackening etc. The lines have broadly two groups: one exhibiting sharp, dark and relatively broad lines of Cr I and the other defined defused, faint, and full in length belonging to Cr II. These two spectra of Chromium have been studied in the present work.

5.2 Spectral analysis of Cr I

Neutral Chromium (Cr I) has 24 electrons and its electronic configuration is given as: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s$ with $^7S_3$ as its ground most level. Thus $3d^5 4s$ is the ground configuration and the excited configurations are of the type $3d^5 4p$, $3d^5 4d$, $3d^5 4f$,----. The core excitation leads to $3d^4 4s4p$, $3d^4 4s^2$ and $3d^4 4s4f$,---- configurations. This is a six electron spectrum and is extremely complicated. Same multiplets appear several times. It is therefore, very difficult to designate levels without ambiguity.

The ground configuration alone has 74 energy levels and the excited configurations considered are as follows:

$3d^4 4s^2$: 34 levels

$3d^5 4p$: 214 levels

$3d^5 4d$: 332 levels

$3d^4 4s4p$: 360 levels

Thus it is clear that a huge number of levels (more than a thousand) are involved and showing interaction between them. The first work on the spectrum of this atom started as early as in 1907 by W. Miller [**1**] followed by a number of workers R. Richter [**2**], C.C. Keiss & W.F. Meggers [**3**], M.A. Catelan [**4**], H Giessier [**5**], again by C.C. Keiss & H.K. Kiess [**6**], Gieseler [**7**], C.C. Kiess [**8**], C.C. Kiess [**9**] and unpublished material by C.C. Kiess [**10**], as cited and compiled by C.E. Moore in Atomic Energy Levels (AEL), Vol II [**11**]. More recently, Sugar and Corlis [**12**] published levels of Cr I which is also listed on NIST website. In the present work, we used levels from ref. [**12**] to study its structure. Recently we developed facilities to record spectra on 21-ft and 35–ft grating spectrographs of our spectroscopy laboratory at Aligarh. This project is basically a facility test which is now functional at Aligarh. In near future, we expect to undertake more ions of unknown structure by using our 3-m normal incidence vacuum spectrograph in vacuum ultraviolet region. As mentioned earlier the spectra recorded cover 4800 Å to 5500 Å wavelength region. Thus a few lines have been observed to fall in this wavelength region which has been used to identify the published levels. We observed transitions from 25 levels of the ground configuration $3d^54s$ to $3d^54p$, and $3d^44s4p$. In the process, 28 levels of $3d^54p$ and 16 levels of $3d^44s4p$ configurations have been verified. Our values agree quite well with the reported levels. Also, transitions between the excited configurations have been observed and that helped us to identify 14 levels of $3d^44s^2$, and 3 levels of $3d^54d$ configurations. All these observed levels have been given in Table IX.

5.3 Theoretical interpretation of Cr I:

It is almost impossible to study such a complicated structure without some sophisticated calculations. R.D. Cowan's Computer code [13] has been used to predict the energy level structure and associated transition probabilities.

In the even parity system $3d^54s$, $3d^44s^2$ and $3d^54d$ configurations, were considered for configuration interaction effect while $3d^54p$ and $3d^44s4p$ were mixed for odd parity configurations. The ab initio scaling of the energy parameters were as:

E_{av} & ζ = 100% of HFR values.

F^k = 85% of HFR values.

G^k = 75% of HFR values.

R^k = 80% of HFR values.

With above scaling, we got reasonable predictions and analysis was carried out in the guidance of predicted transition probabilities. Only strong predicted transitions could be seen in our recordings. The levels were used to run least square fitted(LSF) parametric calculations. This allowed to adjust the energy parameters to the real values and hence a better prediction was achieved. The major contribution of this least squares calculations is that the large number of unknown levels are now predicted with much better accuracy and these calculations can be used for future study of Cr I with better experimental recordings. All the observed and least squares fitted energy levels of even and odd parity configurations are given in Table I and Table II respectively along with their LS percentage compositions. All the least squares fitted energy parameters of even and odd parity configurations are given in Table V and Table VI respectively.

As mentioned earlier that unambiguous level designation is not possible, therefore E(J) notation is more appropriate where E is the energy of the level in cm^{-1} and J is its corresponding J value. The notation under LS composition section is the most recent LS designation adapted at National Institute of Standards and Technology (NIST) Gaithersburg, Maryland, U.S.A. The configuration gross structure has been shown in Grotorian diagram (Fig.5.1), showing possible transitions between them.

5.4 Spectral analysis and theoretical interpretation of Cr II:

The first work on Cr II was carried out by C. C. Kiess [**14**] followed by H. N. Russel [**15**] and then again by C. C. Kiess in 1951 [**16**]. The wavelength region covered by C. C. Kiess was from 1700Å to 7300Å. He has classified 1950 spectral lines and has established about 500 levels. All this work is available in Atomic energy level [**11**]. However, More recent data is available in the compilation by Corliss and Sugar [**12**] and NIST website.

The singly ionized Chromium (Cr II) has ground configuration $3d^5$ and the excited configurations are $3d^44s$, $3d^44p$, $3d^44f$ etc. and the core excitation gives rise to $3p^53d^6$ and $3p^53d^54s$ configurations. The further excitation constitutes $3d^34s4p$ configuration etc. This ion gives very complicated structure. For instance the ground configuration has 37 energy levels and the considered excited configurations as follows:

$3d^44s$: 63 levels

$3d^44p$: 180 levels

$3d^44f$: 346 levels

$3d^34s4p$: 213 levels

$3p^53d^6$: 180 levels

$3p^53d^54s$: 417 levels

One of the internally excited configurations, namely $3p^53d^54s$ leads to a 7-electron system. This obviously has extremely complicated level structure and is very difficult to study and to the best of our knowledge this configuration has never been studied so far. We have considered the configurations $3d^5$, $3d^44s$, $3d^44p$, $3d^44f$, and

$3d^3 4s4p$ and have run least squares fitted(LSF) parametric calculation to interpret the observed level system. The least squares calculation shows reasonably good fit with the standard deviations for even and odd parities, 428 $cm^{-1}$and 458 cm^{-1} respectively. A few levels show large deviations, probably some other interacting configuration is still missing in the least squares fit. The configuration gross structure has been depicted in Grotorian diagram (Fig.5.2) showing possible transitions between them. In our recorded spectrum, a few lines of Cr II fall in our wavelength region. So we were able to verify 21 levels of Cr II. The observed levels in the present study have been included in Table X. All the observed and least squares fitted energy levels of even and odd parity configurations are given in Table III and Table IV respectively along with their LS percentage compositions. All the least squares fitted energy parameters of even and odd parity configurations are given in Table VII and Table VIII respectively.

In conclusion, we can say that we have observed 63 levels of Cr I and Cr II in the present investigations. These observed energy levels are in reasonably good agreement with those calculated ones. Besides known levels, about 650 levels in Cr I and 698 levels in Cr II have been predicted theoretically.

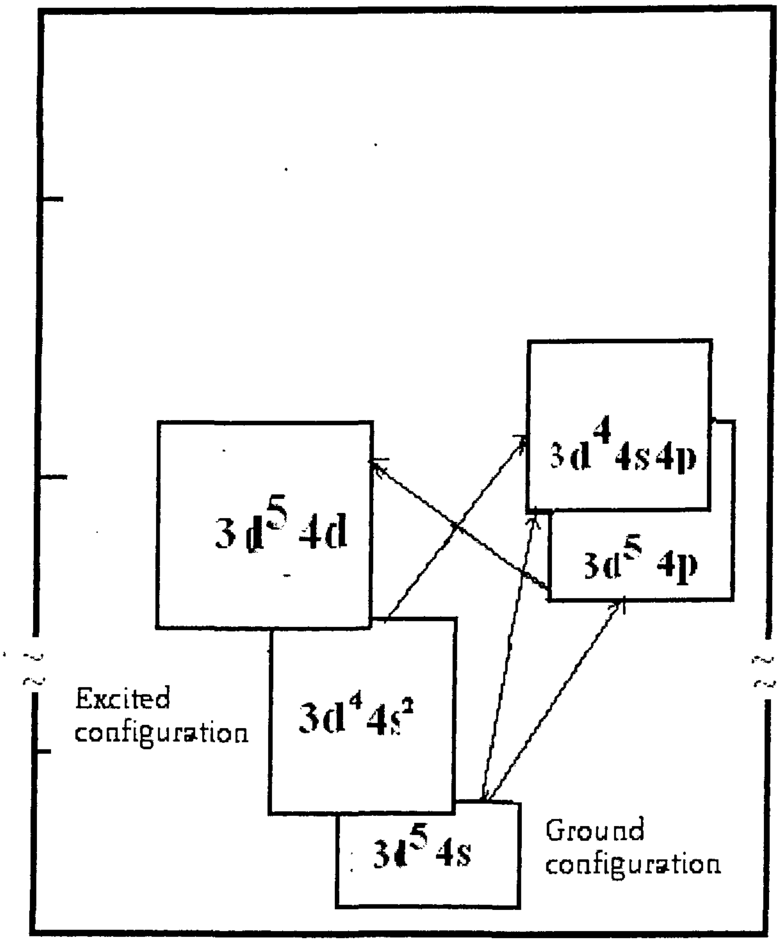

Fig 5.1-: Grotorian diagram of Cr I (Not to the scale)

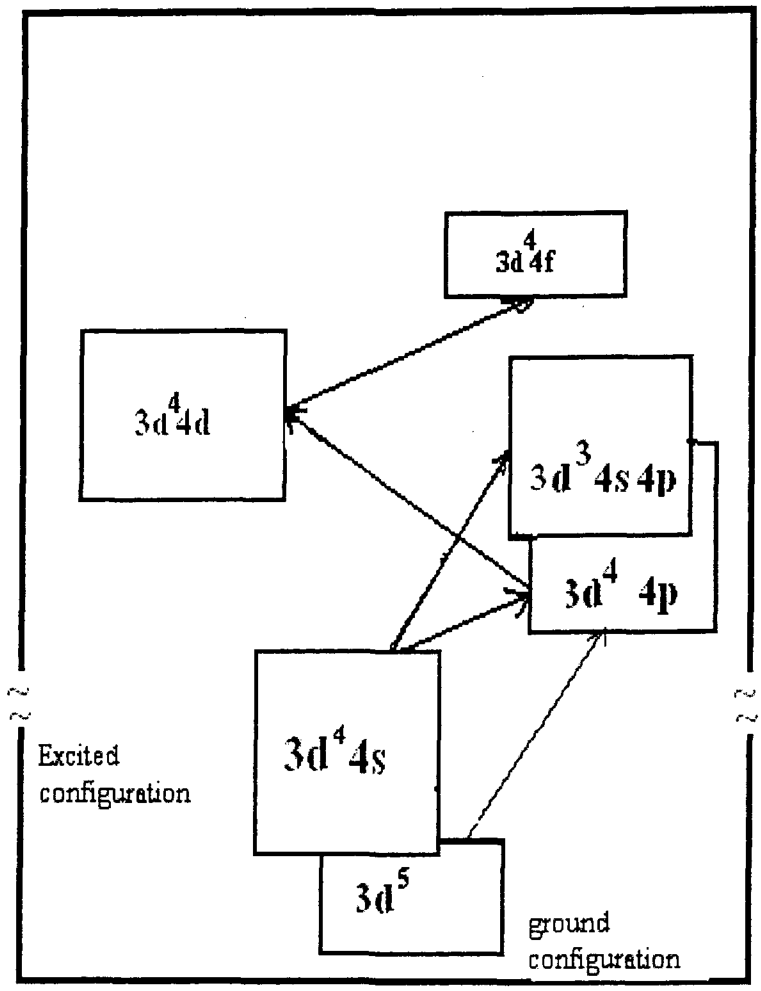

Fig 5.2-: Grotorian diagram of Cr II (Not to the scale)

Table I.

Observed and least squares fitted energy levels of even parity configurations of Cr I in cm^{-1}:

1

J	E(obs)	E(LSF)	diff.	LS-composition.
0	7751.0	7860.0	-109.0	99% 3d4 4s2 <4>5D
	23163.0	23557.0	-394.0	54% 3d4 4s2 <4>3P + 32% 3d4 4s2 <2>3P
	24277.0	24074.0	203.0	99% 3d5 4s (<5>4D)5D
	27163.0	28153.0	-990.0	86% 3d5 4s (<3>4P)3P + 7% 3d4 4s2 <2>3P
	-	34358.0	-	69% 3d4 4s2 <4>1S + 18% 3d4 4s2 <0>1S
	44093.0	44038.0	55.0	99% 3d5 4d (<5>6S)5D
	-	45731.0	-	87% 3d5 4s (<5>2S)1S + 9% 3d4 4s2 <4>1S
	-	49525.0	-	58% 3d4 4s2 <2>3P + 39% 3d4 4s2 <4>3P
	-	61348.0	-	97% 3d5 4s (<3>2P)3P
	-	63953.0	-	82% 3d5 4d (<5>4G)5D + 10% 3d5 4d (<3>4P)5D
	-	66319.0	-	65% 3d5 4d (<3>4P)5D + 34% 3d5 4d (<5>4D)5D
	-	67675.0	-	78% 3d5 4d (<3>4P)3P + 18% 3d5 4d (<5>4D)3P
	-	69485.0	-	52% 3d5 4d (<5>4D)5D + 22% 3d5 4d (<3>4P)5D
	-	69756.0	-	73% 3d5 4d (<5>4D)3P + 14% 3d5 4d (<3>4P)3P
	-	75765.0	-	45% 3d5 4d (<5>2D)3P + 35% 3d5 4d (<3>2F)3P
	-	78002.0	-	70% 3d5 4d (<3>4F)3P + 12% 3d5 4d (<5>2D)3P
	-	79220.0	-	87% 3d5 4d (<3>4F)5D + 5% 3d5 4d (<5>4D)5D
	-	80356.0	-	33% 3d5 4d (<3>2F)3P + 21% 3d5 4d (<5>2F)3P
	-	81500.0	-	64% 3d5 4d (<5>2D)1S + 14% 3d5 4d (<1>2D)1S
	-	84499.0	-	63% 3d5 4d (<5>2F)3P + 18% 3d5 4d (<3>2F)3P
	-	88616.0	-	78% 3d4 4s2 <0>1S + 22% 3d4 4s2 <4>1S
	-	91762.0	-	96% 3d5 4d (<3>2D)3P
	-	94063.0	-	92% 3d5 4d (<3>2D)1S + 5% 3d5 4d (<5>2D)1S
	-	106863.0	-	95% 3d5 4d (<3>2P)3P
	-	113198.0	-	75% 3d5 4d (<1>2D)3P + 20% 3d5 4d (<5>2D)3P
	-	119515.0	-	80% 3d5 4d (<1>2D)1S + 19% 3d5 4d (<5>2D)1S
1	7811.0	7922.0	-111.0	99% 3d4 4s2 <4>5D
	21857.0	21988.0	-131.0	99% 3d5 4s (<3>4P)5P
	23512.0	23877.0	-365.0	53% 3d4 4s2 <4>3P + 31% 3d4 4s2 <2>3P
	24287.0	24089.0	198.0	98% 3d5 4s (<5>4D)5D
	27176.0	28143.0	-967.0	74% 3d5 4s (<3>4P)3P + 8% 3d5 4s (<5>4D)3D
	28679.0	28735.0	-56.0	62% 3d5 4s (<5>4D)3D + 20% 3d4 4s2 <4>3D
	31049.0	30901.0	148.0	45% 3d5 4s (<5>2D)3D + 24% 3d5 4s (<5>4D)3D
	31352.0	32093.0	-741.0	98% 3d5 4s (<3>4F)5F
	33907.0	34642.0	-735.0	59% 3d4 4s2 <4>3D + 25% 3d5 4s (<5>2D)3D
	-	41594.0	-	100% 3d5 4s (<5>2S)3S
	42253.0	42254.0	-1.0	100% 3d5 4d (<5>6S)7D
	44089.0	44039.0	50.0	99% 3d5 4d (<5>6S)5D
	-	45979.0	-	99% 3d5 4s (<3>2D)3D
	-	49300.0	-	59% 3d4 4s2 <2>3P + 38% 3d4 4s2 <4>3P
	-	61336.0	-	97% 3d5 4s (<3>2P)3P
	-	62654.0	-	100% 3d5 4d (<5>4G)5F
	-	63302.0	-	93% 3d5 4d (<5>4G)3D + 4% 3d5 4d (<5>4D)3D
	-	63800.0	-	99% 3d5 4s (<3>2P)1P
	-	63948.0	-	82% 3d5 4d (<5>4G)5D + 10% 3d5 4d (<3>4P)5D
	-	65765.0	-	75% 3d5 4s (<1>2D)3D + 24% 3d5 4s (<5>2D)3D
	-	66090.0	-	87% 3d5 4d (<3>4P)5P + 9% 3d5 4d (<5>4D)5P
	-	66182.0	-	95% 3d5 4d (<3>4P)5F + 5% 3d5 4d (<5>4D)5F
	-	66351.0	-	62% 3d5 4d (<3>4P)5D + 31% 3d5 4d (<5>4D)5D
	-	66896.0	-	80% 3d5 4d (<3>4P)3D + 9% 3d5 4d (<5>4D)3D
	-	67228.0	-	81% 3d5 4d (<5>4D)5P + 9% 3d5 4d (<3>4P)5P
	-	67272.0	-	86% 3d5 4d (<5>4D)5F + 7% 3d5 4d (<3>4P)3D
	-	67411.0	-	68% 3d5 4d (<5>4D)3S + 18% 3d5 4d (<3>4P)3P
	-	67891.0	-	57% 3d5 4d (<3>4P)3P + 26% 3d5 4d (<5>4D)3S
	-	69059.0	-	80% 3d5 4d (<5>4D)3D + 7% 3d5 4d (<3>4P)3D
	-	69476.0	-	51% 3d5 4d (<5>4D)5D + 20% 3d5 4d (<3>4P)5D
	-	69665.0	-	73% 3d5 4d (<5>4D)3P + 12% 3d5 4d (<3>4P)3P
	-	75463.0	-	50% 3d5 4d (<5>2D)3S + 14% 3d5 4d (<1>2D)3S
	-	75659.0	-	28% 3d5 4d (<3>4F)5F + 21% 3d5 4d (<5>2D)1P
	-	75761.0	-	27% 3d5 4d (<5>2D)1P + 25% 3d5 4d (<3>4F)5F
	-	75837.0	-	36% 3d5 4d (<3>4F)5P + 18% 3d5 4d (<5>2D)1P
	-	76007.0	-	40% 3d5 4d (<3>4F)5F + 24% 3d5 4d (<3>4F)3D
	-	76137.0	-	39% 3d5 4d (<3>4F)5P + 18% 3d5 4d (<5>2D)3S
	-	76529.0	-	39% 3d5 4d (<3>4F)3D + 22% 3d5 4d (<5>2D)3D
	-	76711.0	-	87% 3d5 4d (<3>2F)1P
	-	77051.0	-	59% 3d5 4d (<3>2F)3D + 19% 3d5 4d (<3>4F)3D
	-	77958.0	-	65% 3d5 4d (<3>4F)3P + 12% 3d5 4d (<5>2D)3P
	-	79181.0	-	62% 3d5 4d (<3>4F)5D + 25% 3d5 4d (<5>2G)3D
	-	79234.0	-	63% 3d5 4d (<5>2G)3D + 25% 3d5 4d (<3>4F)5D
	-	80532.0	-	41% 3d5 4d (<3>2F)3P + 23% 3d5 4d (<5>2F)3P
	-	81582.0	-	99% 3d5 4d (<5>2F)1P
	-	82824.0	-	79% 3d5 4d (<5>2F)3D + 10% 3d5 4d (<5>2S)3D

	-	84376.0	-	66% 3d5 4d (<5>2F)3P + 17% 3d5 4d (<3>2F)3P
	-	86000.0	-	86% 3d5 4d (<5>2S)3D + 5% 3d5 4d (<3>2D)3D
	-	90131.0	-	100% 3d5 4d (<3>2D)3S
	-	90209.0	-	100% 3d5 4d (<3>2D)1P
	-	91218.0	-	87% 3d5 4d (<3>2D)3D + 7% 3d5 4d (<3>2G)3D
	-	91773.0	-	95% 3d5 4d (<3>2D)3P
	-	95704.0	-	92% 3d5 4d (<3>2G)3D + 5% 3d5 4d (<3>2D)3D
	-	105736.0	-	100% 3d5 4d (<3>2P)1P
	-	105859.0	-	99% 3d5 4d (<3>2P)3D
	-	106823.0	-	94% 3d5 4d (<3>2P)3P
	-	111106.0	-	79% 3d5 4d (<1>2D)3S + 21% 3d5 4d (<5>2D)3S
	-	111298.0	-	78% 3d5 4d (<1>2D)1P + 21% 3d5 4d (<5>2D)1P
	-	111399.0	-	78% 3d5 4d (<1>2D)3D + 22% 3d5 4d (<5>2D)3D
	-	113244.0	-	74% 3d5 4d (<1>2D)3P + 20% 3d5 4d (<5>2D)3P
2	7927.0	8044.0	-117.0	99% 3d4 4s2 <4>5D
	7593.0	8210.0	-617.0	100% 3d5 4s (<5>6S)5S
	20517.0	20168.0	349.0	100% 3d5 4s (<5>4G)5G
	21848.0	21968.0	-120.0	98% 3d5 4s (<3>4P)5P
	24093.0	24104.0	-11.0	97% 3d5 4s (<5>4D)5D
	24300.0	24430.0	-130.0	51% 3d4 4s2 <4>3P + 28% 3d4 4s2 <2>3P
	24941.0	25049.0	-108.0	77% 3d4 4s2 <4>3F + 21% 3d4 4s2 <2>3F
	27223.0	28196.0	-973.0	61% 3d5 4s (<3>4P)3P + 15% 3d5 4s (<5>4D)3D
	28682.0	28769.0	-87.0	54% 3d5 4s (<5>4D)3D + 19% 3d4 4s2 <4>3D
	31028.0	30876.0	152.0	44% 3d5 4s (<5>2D)3D + 25% 3d5 4s (<5>4D)3D
	31355.0	32089.0	-734.0	99% 3d5 4s (<3>4F)5F
	33040.0	32636.0	404.0	94% 3d5 4s (<3>2F)3F
	33936.0	34610.0	-674.0	55% 3d4 4s2 <4>3D + 24% 3d5 4s (<5>2D)3D
	35808.0	34860.0	948.0	70% 3d5 4s (<5>2D)1D + 22% 3d5 4s (<1>2D)1D
	-	37632.0	-	66% 3d4 4s2 <4>1D + 18% 3d4 4s2 <2>1D
	-	37706.0	-	78% 3d5 4s (<3>4F)3F + 11% 3d4 4s2 <4>1D
	-	38552.0	-	90% 3d5 4s (<5>2F)3F + 7% 3d5 4s (<3>4F)3F
	42255.0	42255.0	0.0	100% 3d5 4d (<5>6S)7D
	44081.0	44040.0	41.0	99% 3d5 4d (<5>6S)5D
	-	45985.0	-	99% 3d5 4s (<3>2D)3D
	-	48557.0	-	96% 3d5 4s (<3>2D)1D
	-	48855.0	-	59% 3d4 4s2 <2>3P + 38% 3d4 4s2 <4>3P
	-	49006.0	-	75% 3d4 4s2 <2>3F + 22% 3d4 4s2 <4>3F
	-	61316.0	-	97% 3d5 4s (<3>2P)3P
	-	62657.0	-	99% 3d5 4d (<5>4G)5F
	62647.0	62678.0	-31.0	99% 3d5 4d (<5>4G)5G
	-	63322.0	-	93% 3d5 4d (<5>4G)3D
	-	63936.0	-	81% 3d5 4d (<5>4G)5D + 10% 3d5 4d (<3>4P)5D
	-	64169.0	-	89% 3d5 4d (<5>4G)3F + 5% 3d5 4d (<5>4D)3F
	-	65751.0	-	76% 3d5 4s (<1>2D)3D + 24% 3d5 4s (<5>2D)3D
	-	66132.0	-	86% 3d5 4d (<3>4P)5P + 5% 3d5 4d (<3>4P)5D
	-	66171.0	-	94% 3d5 4d (<3>4P)5F
	-	66420.0	-	58% 3d5 4d (<3>4P)5D + 26% 3d5 4d (<5>4D)5D
	-	66781.0	-	78% 3d5 4d (<3>4P)3D + 12% 3d5 4d (<5>4D)3D
	-	67103.0	-	74% 3d5 4d (<5>4D)5G + 13% 3d5 4d (<3>4P)3F
	-	67148.0	-	90% 3d5 4d (<5>4D)5P
	-	67264.0	-	81% 3d5 4d (<5>4D)5F + 6% 3d5 4d (<5>4D)5G
	-	67339.0	-	92% 3d5 4d (<5>4D)5S + 4% 3d5 4d (<3>4P)5P
	-	67402.0	-	56% 3d5 4d (<3>4P)3F + 23% 3d5 4d (<5>4D)3F
	-	67960.0	-	81% 3d5 4d (<3>4P)3P + 9% 3d5 4d (<5>4D)3P
	-	68162.0	-	65% 3d5 4s (<1>2D)1D + 21% 3d5 4s (<5>2D)1D
	-	68665.0	-	64% 3d5 4d (<5>4D)3F + 22% 3d5 4d (<3>4P)3F
	-	69191.0	-	75% 3d5 4d (<5>4D)3D + 10% 3d5 4d (<3>4P)3D
	-	69446.0	-	36% 3d5 4d (<5>4D)5D + 27% 3d5 4d (<5>4D)3P
	-	69510.0	-	52% 3d5 4d (<5>4D)3P + 19% 3d5 4d (<5>4D)5D
	-	70991.0	-	67% 3d4 4s2 <2>1D + 18% 3d4 4s2 <4>1D
	-	75627.0	-	27% 3d5 4d (<5>2D)3D + 15% 3d5 4d (<3>2F)3F
	-	75758.0	-	50% 3d5 4d (<3>4F)5F + 19% 3d5 4d (<3>4F)5G
	-	75857.0	-	76% 3d5 4d (<3>4F)5P + 10% 3d5 4d (<5>2D)3P
	-	75939.0	-	51% 3d5 4d (<3>4F)5G + 28% 3d5 4d (<3>4F)5F
	-	76116.0	-	20% 3d5 4d (<5>2D)3P + 19% 3d5 4d (<3>4F)3D
	-	76151.0	-	17% 3d5 4d (<5>2D)3D + 12% 3d5 4d (<3>4F)3D
	-	76283.0	-	28% 3d5 4d (<5>2D)1D + 18% 3d5 4d (<5>2D)3F
	-	76506.0	-	38% 3d5 4d (<3>4F)3D + 18% 3d5 4d (<5>2D)3D
	-	76983.0	-	56% 3d5 4d (<3>2F)3D + 9% 3d5 4d (<3>2F)3F
	-	77246.0	-	47% 3d5 4d (<3>2F)3F + 9% 3d5 4d (<5>2D)3F
	-	77555.0	-	48% 3d5 4d (<3>4F)3F + 39% 3d5 4d (<3>2H)3F
	-	77843.0	-	56% 3d5 4d (<3>4F)3P + 12% 3d5 4d (<5>2D)3P
	-	78479.0	-	47% 3d5 4d (<3>2F)1D + 32% 3d5 4d (<5>2G)1D
	-	79128.0	-	70% 3d5 4d (<3>4F)5D + 17% 3d5 4d (<5>2G)3D
	-	79226.0	-	70% 3d5 4d (<5>2G)3D + 17% 3d5 4d (<3>4F)5D
	-	80063.0	-	53% 3d5 4d (<5>2G)3F + 19% 3d5 4d (<5>2F)3F
	-	80367.0	-	23% 3d5 4d (<3>2F)3P + 16% 3d5 4d (<5>2F)1D
	-	80653.0	-	25% 3d5 4d (<5>2F)1D + 21% 3d5 4d (<3>2F)3P
	-	81512.0	-	45% 3d5 4d (<5>2F)3F + 25% 3d5 4d (<3>2H)3F
	-	82866.0	-	78% 3d5 4d (<5>2F)3D + 10% 3d5 4d (<5>2S)3D
	-	82920.0	-	47% 3d5 4d (<5>2F)1D + 20% 3d5 4d (<5>2S)1D
	-	83610.0	-	29% 3d5 4d (<5>2F)3F + 27% 3d5 4d (<3>2H)3F
	-	84136.0	-	71% 3d5 4d (<5>2F)3P + 14% 3d5 4d (<3>2F)3P
	-	86012.0	-	85% 3d5 4d (<5>2S)3D + 6% 3d5 4d (<5>2F)3D
	-	87214.0	-	71% 3d5 4d (<5>2S)1D + 11% 3d5 4d (<3>2D)1D

	-	90882.0	-	95% 3d5 4d (<3>2D)3F
	-	91199.0	-	87% 3d5 4d (<3>2D)3D + 7% 3d5 4d (<3>2G)3D
	-	91803.0	-	95% 3d5 4d (<3>2D)3P
	-	92898.0	-	75% 3d5 4d (<3>2D)1D + 10% 3d5 4d (<3>2G)1D
	-	95726.0	-	91% 3d5 4d (<3>2G)3D + 5% 3d5 4d (<3>2D)3D
	-	96707.0	-	95% 3d5 4d (<3>2G)3F
	-	97439.0	-	83% 3d5 4d (<3>2G)1D + 10% 3d5 4d (<3>2D)1D
	-	105846.0	-	99% 3d5 4d (<3>2P)3D
	-	106154.0	-	96% 3d5 4d (<3>2F)3F
	-	106750.0	-	94% 3d5 4d (<3>2P)3P + 5% 3d5 4d (<1>2D)3P
	-	108044.0	-	79% 3d5 4d (<3>2F)1D + 14% 3d5 4d (<1>2D)1D
	-	111401.0	-	78% 3d5 4d (<1>2D)3D + 22% 3d5 4d (<5>2D)3D
	-	113055.0	-	76% 3d5 4d (<1>2D)3F + 20% 3d5 4d (<5>2D)3F
	-	113335.0	-	73% 3d5 4d (<1>2D)3P + 20% 3d5 4d (<5>2D)3P
	-	114336.0	-	63% 3d5 4d (<1>2D)1D + 18% 3d5 4d (<5>2D)1D
3	0.0	-203.0	203.0	100% 3d5 4s (<5>6S)7S
	8095.0	8222.0	-127.0	99% 3d4 4s2 <4>5D
	20521.0	20173.0	348.0	100% 3d5 4s (<5>4G)5G
	21841.0	21952.0	-111.0	98% 3d5 4s (<3>4P)5P
	24304.0	24108.0	196.0	97% 3d5 4s (<5>4D)5D
	24834.0	24782.0	52.0	56% 3d5 4s (<5>4G)3G + 30% 3d4 4s2 <4>3G
	25106.0	25169.0	-63.0	66% 3d4 4s2 <4>3F + 17% 3d4 4s2 <2>3F
	27597.0	27780.0	-183.0	67% 3d4 4s2 <4>3G + 31% 3d5 4s (<5>4G)3G
	28637.0	28621.0	16.0	68% 3d5 4s (<5>4D)3D + 23% 3d4 4s2 <4>3D
	31009.0	30854.0	155.0	44% 3d5 4s (<5>2D)3D + 25% 3d5 4s (<5>4D)3D
	31364.0	32085.0	-721.0	99% 3d5 4s (<3>4F)5F
	33061.0	32707.0	354.0	95% 3d5 4s (<3>2F)3F
	33935.0	34584.0	-649.0	56% 3d4 4s2 <4>3D + 24% 3d5 4s (<5>2D)3D
	-	35163.0	-	88% 3d5 4s (<3>2F)1F + 6% 3d4 4s2 <4>1F
	35814.0	36351.0	-537.0	97% 3d5 4s (<5>2G)3G
	37206.0	37722.0	-516.0	95% 3d5 4s (<3>4F)3F
	-	38514.0	-	95% 3d5 4s (<5>2F)3F
	-	40088.0	-	70% 3d5 4s (<5>2F)1F + 25% 3d4 4s2 <4>1F
	42256.0	42256.0	0.0	100% 3d5 4d (<5>6S)7D
	44069.0	44044.0	25.0	99% 3d5 4d (<5>6S)5D
	-	44081.0	-	68% 3d4 4s2 <4>1F + 28% 3d5 4s (<5>2F)1F
	-	45998.0	-	99% 3d5 4s (<3>2D)3D
	-	49002.0	-	77% 3d4 4s2 <2>3F + 21% 3d4 4s2 <4>3F
	-	51096.0	-	100% 3d5 4s (<3>2G)3G
	-	62560.0	-	100% 3d5 4d (<5>4G)5H
	62662.0	62660.0	2.0	99% 3d5 4d (<5>4G)5F
	-	62682.0	-	99% 3d5 4d (<5>4G)5G
	-	63339.0	-	94% 3d5 4d (<5>4G)3D
	-	63762.0	-	94% 3d5 4d (<5>4G)3G
	-	63919.0	-	80% 3d5 4d (<5>4G)5D + 10% 3d5 4d (<3>4P)5D
	-	64178.0	-	90% 3d5 4d (<5>4G)3F + 4% 3d5 4d (<3>4P)3F
	-	65741.0	-	76% 3d5 4s (<1>2D)3D + 24% 3d5 4s (<5>2D)3D
	-	66157.0	-	92% 3d5 4d (<3>4P)5F + 6% 3d5 4d (<5>4D)5G
	-	66181.0	-	86% 3d5 4d (<3>4P)5P + 6% 3d5 4d (<3>4P)5D
	-	66533.0	-	55% 3d5 4d (<3>4P)5D + 22% 3d5 4d (<5>4D)5D
	-	66627.0	-	75% 3d5 4d (<3>4P)3D + 16% 3d5 4d (<5>4D)3D
	-	67099.0	-	41% 3d5 4d (<5>4D)5G + 30% 3d5 4d (<3>4P)3F
	-	67139.0	-	94% 3d5 4d (<5>4D)5P
	-	67248.0	-	43% 3d5 4d (<5>4D)5F + 38% 3d5 4d (<5>4D)5G
	-	67299.0	-	35% 3d5 4d (<5>4D)5F + 29% 3d5 4d (<3>4P)3F
	-	68318.0	-	82% 3d5 4d (<5>4D)3G + 8% 3d5 4d (<5>4D)3F
	-	68791.0	-	55% 3d5 4d (<5>4D)3F + 26% 3d5 4d (<3>4P)3F
	-	69373.0	-	68% 3d5 4d (<5>4D)3D + 14% 3d5 4d (<3>4P)3D
	-	69440.0	-	53% 3d5 4d (<5>4D)5D + 18% 3d5 4d (<3>4P)5D
	-	72684.0	-	86% 3d5 4d (<5>2I)3G
	-	75584.0	-	46% 3d5 4d (<5>2D)3G + 31% 3d5 4d (<3>4F)5H
	-	75639.0	-	43% 3d5 4d (<5>2D)3D + 12% 3d5 4d (<1>2D)3D
	-	75766.0	-	33% 3d5 4d (<5>2D)1F + 14% 3d5 4d (<3>4F)5F
	-	75796.0	-	50% 3d5 4d (<3>4F)5F + 18% 3d5 4d (<5>2D)1F
	-	75908.0	-	74% 3d5 4d (<3>4F)5P + 16% 3d5 4d (<3>4F)5G
	-	75930.0	-	50% 3d5 4d (<3>4F)5G + 23% 3d5 4d (<3>4F)5P
	-	76046.0	-	57% 3d5 4d (<3>4F)5H + 22% 3d5 4d (<5>2D)3G
	-	76206.0	-	27% 3d5 4d (<5>2D)3F + 16% 3d5 4d (<3>4F)5G
	-	76253.0	-	77% 3d5 4d (<3>4F)3D + 15% 3d5 4d (<3>2F)3D
	-	76611.0	-	43% 3d5 4d (<3>4F)3G + 25% 3d5 4d (<3>2F)3G
	-	76863.0	-	59% 3d5 4d (<3>2F)1F + 13% 3d5 4d (<3>2F)3F
	-	76927.0	-	50% 3d5 4d (<3>2F)3D + 21% 3d5 4d (<3>2F)3F
	-	77203.0	-	26% 3d5 4d (<3>2F)3F + 14% 3d5 4d (<3>2F)3D
	-	77298.0	-	28% 3d5 4d (<3>2F)3G + 13% 3d5 4d (<3>2F)1F
	-	77607.0	-	50% 3d5 4d (<3>4F)3F + 37% 3d5 4d (<3>2H)3F
	-	78448.0	-	65% 3d5 4d (<3>2H)3G + 29% 3d5 4d (<5>2G)3G
	-	78759.0	-	69% 3d5 4d (<3>2H)1F + 15% 3d5 4d (<5>2G)1F
	-	79058.0	-	81% 3d5 4d (<3>4F)5D + 5% 3d5 4d (<5>2G)3D
	-	79221.0	-	75% 3d5 4d (<5>2G)3D + 7% 3d5 4d (<3>4F)5D
	-	79999.0	-	39% 3d5 4d (<5>2G)1F + 27% 3d5 4d (<5>2F)1F
	-	80044.0	-	45% 3d5 4d (<5>2G)3F + 17% 3d5 4d (<5>2F)3F
	-	81284.0	-	87% 3d5 4d (<5>2F)3G
	-	81563.0	-	41% 3d5 4d (<5>2F)3F + 25% 3d5 4d (<3>2H)3F
	-	82422.0	-	45% 3d5 4d (<5>2G)3G + 16% 3d5 4d (<3>2H)3G
	-	82919.0	-	78% 3d5 4d (<5>2F)3D + 11% 3d5 4d (<5>2S)3D

	-	83601.0	-	31% 3d5 4d (<5>2F)3F + 26% 3d5 4d (<3>2H)3F
	-	85575.0	-	55% 3d5 4d (<5>2F)1F + 21% 3d5 4d (<5>2G)1F
	-	86030.0	-	84% 3d5 4d (<5>2S)3D + 6% 3d5 4d (<5>2F)3D
	-	90575.0	-	96% 3d5 4d (<3>2D)3G
	-	90874.0	-	95% 3d5 4d (<3>2D)3F
	-	91170.0	-	87% 3d5 4d (<3>2D)3D + 7% 3d5 4d (<3>2G)3D
	-	92208.0	-	84% 3d5 4d (<3>2D)1F + 7% 3d5 4d (<5>2F)1F
	-	94694.0	-	99% 3d5 4d (<3>2G)1F
	-	95429.0	-	96% 3d5 4d (<3>2G)3G
	-	95760.0	-	91% 3d5 4d (<3>2G)3D + 5% 3d5 4d (<3>2D)3D
	-	96722.0	-	95% 3d5 4d (<3>2G)3F
	-	105829.0	-	99% 3d5 4d (<3>2P)3D
	-	106174.0	-	96% 3d5 4d (<3>2P)3F
	-	106560.0	-	98% 3d5 4d (<3>2P)1F
	-	111306.0	-	78% 3d5 4d (<1>2D)3G + 21% 3d5 4d (<5>2D)3G
	-	111402.0	-	78% 3d5 4d (<1>2D)3D + 21% 3d5 4d (<5>2D)3D
	-	111530.0	-	77% 3d5 4d (<1>2D)1F + 22% 3d5 4d (<5>2D)1F
	-	113030.0	-	76% 3d5 4d (<1>2D)3F + 20% 3d5 4d (<5>2D)3F
4	8308.0	8450.0	-142.0	99% 3d4 4s2 <4>5D
	20524.0	20178.0	346.0	100% 3d5 4s (<5>4G)5G
	23934.0	23000.0	934.0	99% 3d4 4s2 <4>3H
	24282.0	24072.0	210.0	99% 3d5 4s (<5>4D)5D
	24898.0	24837.0	61.0	57% 3d5 4s (<5>4G)3G + 28% 3d4 4s2 <4>3G
	25177.0	25241.0	-64.0	66% 3d4 4s2 <4>3F + 16% 3d4 4s2 <2>3F
	27704.0	27889.0	-185.0	68% 3d4 4s2 <4>3G + 29% 3d5 4s (<5>4G)3G
	31987.0	31241.0	746.0	62% 3d4 4s2 <4>1G + 30% 3d4 4s2 <2>1G
	31378.0	32079.0	-701.0	99% 3d5 4s (<3>4F)5F
	33113.0	32692.0	421.0	99% 3d5 4s (<3>2F)3F
	35863.0	35578.0	285.0	95% 3d5 4s (<3>2H)3H + 4% 3d5 4s (<5>2G)3G
	-	36385.0	-	93% 3d5 4s (<5>2G)3G + 4% 3d5 4s (<3>2H)3H
	37244.0	37731.0	-487.0	96% 3d5 4s (<3>4F)3F
	-	38501.0	-	98% 3d5 4s (<5>2F)3F
	39159.0	39408.0	-249.0	91% 3d5 4s (<5>2G)1G + 5% 3d4 4s2 <2>1G
	42258.0	42258.0	0.0	100% 3d5 4d (<5>6S)7D
	44051.0	44048.0	3.0	99% 3d5 4d (<5>6S)5D
	-	48950.0	-	78% 3d4 4s2 <2>3F + 21% 3d4 4s2 <4>3F
	-	51092.0	-	100% 3d5 4s (<3>2G)3G
	-	53652.0	-	60% 3d5 4s (<3>2G)1G + 22% 3d4 4s2 <2>1G
	-	54551.0	-	43% 3d4 4s2 <2>1G + 39% 3d5 4s (<3>2G)1G
	-	62565.0	-	100% 3d5 4d (<5>4G)5H
	-	62625.0	-	100% 3d5 4d (<5>4G)5I
	-	62661.0	-	100% 3d5 4d (<5>4G)5F
	62671.0	62686.0	-15.0	100% 3d5 4d (<5>4G)5G
	-	63779.0	-	94% 3d5 4d (<5>4G)3G
	-	63894.0	-	80% 3d5 4d (<5>4G)5D + 11% 3d5 4d (<3>4P)5D
	-	64189.0	-	90% 3d5 4d (<5>4G)3F + 4% 3d5 4d (<3>4P)3F
	-	64679.0	-	93% 3d5 4d (<5>4G)3H + 6% 3d5 4d (<5>2I)3H
	-	66144.0	-	92% 3d5 4d (<3>4P)5F + 8% 3d5 4d (<5>4D)5G
	-	66655.0	-	62% 3d5 4d (<3>4P)5D + 23% 3d5 4d (<5>4D)5D
	-	67003.0	-	54% 3d5 4d (<3>4P)3F + 29% 3d5 4d (<5>4D)3F
	-	67212.0	-	83% 3d5 4d (<5>4D)5G + 7% 3d5 4d (<5>4D)5F
	-	67269.0	-	74% 3d5 4d (<5>4D)5F + 7% 3d5 4d (<3>4P)5D
	-	68310.0	-	82% 3d5 4d (<5>4D)3G + 7% 3d5 4d (<5>4D)3F
	-	68921.0	-	52% 3d5 4d (<5>4D)3F + 31% 3d5 4d (<3>4P)3F
	-	69384.0	-	59% 3d5 4d (<5>4D)5D + 17% 3d5 4d (<3>4P)5D
	-	72669.0	-	85% 3d5 4d (<5>2I)3G
	-	72731.0	-	91% 3d5 4d (<5>2I)1G
	-	73367.0	-	80% 3d5 4d (<5>2I)3H + 7% 3d5 4d (<3>4F)3H
	-	75572.0	-	48% 3d5 4d (<5>2D)3G + 19% 3d5 4d (<3>4F)5H
	-	75805.0	-	84% 3d5 4d (<3>4F)5F + 7% 3d5 4d (<5>2D)3F
	-	75916.0	-	77% 3d5 4d (<3>4F)5G + 10% 3d5 4d (<3>4F)5H
	-	75941.0	-	62% 3d5 4d (<3>4F)5H + 8% 3d5 4d (<5>2D)1G
	-	76118.0	-	36% 3d5 4d (<5>2D)1G + 12% 3d5 4d (<5>2D)3G
	-	76158.0	-	34% 3d5 4d (<5>2D)3F + 22% 3d5 4d (<3>2F)3G
	-	76497.0	-	41% 3d5 4d (<3>4F)3G + 17% 3d5 4d (<3>2F)3H
	-	76605.0	-	42% 3d5 4d (<3>4F)3H + 17% 3d5 4d (<3>2F)3H
	-	76828.0	-	77% 3d5 4d (<3>2F)3F + 7% 3d5 4d (<5>2G)3F
	-	77142.0	-	28% 3d5 4d (<3>2F)3H + 17% 3d5 4d (<3>4F)3H
	-	77240.0	-	27% 3d5 4d (<3>2F)3G + 19% 3d5 4d (<3>4F)3G
	-	77609.0	-	46% 3d5 4d (<3>4F)3F + 31% 3d5 4d (<3>2H)3F
	-	77898.0	-	36% 3d5 4d (<3>2F)1G + 19% 3d5 4d (<3>2H)1G
	-	78536.0	-	66% 3d5 4d (<3>2H)3G + 30% 3d5 4d (<5>2G)3G
	-	78850.0	-	93% 3d5 4d (<5>2G)3H + 5% 3d5 4d (<3>2H)3H
	-	78956.0	-	88% 3d5 4d (<3>4F)5D
	-	79443.0	-	73% 3d5 4d (<5>2G)1G + 13% 3d5 4d (<5>2F)1G
	-	79962.0	-	58% 3d5 4d (<5>2G)3F + 22% 3d5 4d (<5>2F)3F
	-	80281.0	-	43% 3d5 4d (<3>2H)3H + 43% 3d5 4d (<5>2F)3H
	-	81283.0	-	86% 3d5 4d (<5>2F)3G + 4% 3d5 4d (<5>2G)3G
	-	81611.0	-	38% 3d5 4d (<5>2F)3F + 26% 3d5 4d (<3>2H)3F
	-	82255.0	-	45% 3d5 4d (<3>2H)1G + 40% 3d5 4d (<5>2F)1G
	-	82379.0	-	44% 3d5 4d (<5>2G)3G + 15% 3d5 4d (<3>2H)3G
	-	83142.0	-	52% 3d5 4d (<5>2F)3H + 23% 3d5 4d (<3>2H)3H
	-	83595.0	-	33% 3d5 4d (<5>2F)3F + 25% 3d5 4d (<3>2H)3F
	-	86265.0	-	38% 3d5 4d (<5>2F)1G + 22% 3d5 4d (<3>2H)1G
	-	90579.0	-	96% 3d5 4d (<3>2D)3G

	-	90830.0	-	93% 3d5 4d (<3>2D)1G + 6% 3d5 4d (<3>2G)1G
	-	90870.0	-	95% 3d5 4d (<3>2D)3F
	-	95301.0	-	97% 3d5 4d (<3>2G)3H
	-	95403.0	-	94% 3d5 4d (<3>2G)3G
	-	96738.0	-	95% 3d5 4d (<3>2G)3F
	-	98427.0	-	89% 3d5 4d (<3>2G)1G + 4% 3d5 4d (<3>2D)1G
	-	106199.0	-	97% 3d5 4d (<3>2P)3F
	-	111302.0	-	78% 3d5 4d (<1>2D)3G + 21% 3d5 4d (<5>2D)3G
	-	112985.0	-	76% 3d5 4d (<1>2D)3F + 20% 3d5 4d (<5>2D)3F
	-	113228.0	-	76% 3d5 4d (<1>2D)1G + 20% 3d5 4d (<5>2D)1G
5	20524.0	20181.0	343.0	100% 3d5 4s (<5>4G)5G
	24056.0	23133.0	923.0	99% 3d4 4s2 <4>3H
	25039.0	24947.0	92.0	72% 3d5 4s (<5>4G)3G + 27% 3d4 4s2 <4>3G
	27817.0	27999.0	-182.0	71% 3d4 4s2 <4>3G + 27% 3d5 4s (<5>4G)3G
	31055.0	30264.0	791.0	100% 3d5 4s (<5>2I)3I
	31393.0	32071.0	-678.0	100% 3d5 4s (<3>4F)5F
	35884.0	35592.0	292.0	94% 3d5 4s (<3>2H)3H + 5% 3d5 4s (<5>2G)3G
	37233.0	36402.0	831.0	92% 3d5 4s (<5>2G)3G + 5% 3d5 4s (<3>2H)3H
	38538.0	38432.0	106.0	99% 3d5 4s (<3>2H)1H
	42261.0	42261.0	0.0	100% 3d5 4d (<5>6S)7D
	-	51086.0	-	100% 3d5 4s (<3>2G)3G
	-	62569.0	-	100% 3d5 4d (<5>4G)5H
	-	62631.0	-	100% 3d5 4d (<5>4G)5I
	-	62660.0	-	99% 3d5 4d (<5>4G)5F
	62691.0	62689.0	2.0	99% 3d5 4d (<5>4G)5G
	-	62957.0	-	100% 3d5 4d (<5>4G)3I
	-	63794.0	-	94% 3d5 4d (<5>4G)3G
	-	64684.0	-	93% 3d5 4d (<5>4G)3H + 6% 3d5 4d (<5>2I)3H
	-	66137.0	-	92% 3d5 4d (<3>4P)5F + 6% 3d5 4d (<5>4D)5G
	-	67162.0	-	53% 3d5 4d (<5>4D)5G + 46% 3d5 4d (<5>4D)5F
	-	67229.0	-	53% 3d5 4d (<5>4D)5F + 41% 3d5 4d (<5>4D)5G
	-	68303.0	-	88% 3d5 4d (<5>4D)3G + 6% 3d5 4d (<5>2I)3G
	-	71592.0	-	100% 3d5 4d (<5>2I)3I
	-	71666.0	-	100% 3d5 4d (<5>2I)1H
	-	72656.0	-	85% 3d5 4d (<5>2I)3G
	-	73401.0	-	80% 3d5 4d (<5>2I)3H + 8% 3d5 4d (<3>4F)3H
	-	75582.0	-	53% 3d5 4d (<5>2D)3G + 15% 3d5 4d (<1>2D)3G
	-	75836.0	-	96% 3d5 4d (<3>4F)5F
	-	75903.0	-	75% 3d5 4d (<3>4F)5H + 19% 3d5 4d (<3>4F)5G
	-	75957.0	-	77% 3d5 4d (<3>4F)5G + 14% 3d5 4d (<3>4F)5H
	-	76387.0	-	46% 3d5 4d (<3>2F)3G + 45% 3d5 4d (<3>4F)3G
	-	76526.0	-	33% 3d5 4d (<3>2F)3H + 32% 3d5 4d (<3>4F)3H
	-	76885.0	-	72% 3d5 4d (<3>2F)1H + 10% 3d5 4d (<5>2D)3G
	-	77076.0	-	22% 3d5 4d (<3>2F)3H + 20% 3d5 4d (<3>2F)3G
	-	77223.0	-	20% 3d5 4d (<3>2F)3H + 18% 3d5 4d (<3>2F)3G
	-	78356.0	-	74% 3d5 4d (<3>2H)3I + 9% 3d5 4d (<5>2G)3H
	-	78516.0	-	57% 3d5 4d (<3>2H)1H + 24% 3d5 4d (<3>2H)3G
	-	78688.0	-	41% 3d5 4d (<3>2H)3G + 32% 3d5 4d (<3>2H)1H
	-	78756.0	-	98% 3d5 4d (<5>2G)3I
	-	78880.0	-	78% 3d5 4d (<5>2G)3H + 9% 3d5 4d (<5>2G)1H
	-	79088.0	-	80% 3d5 4d (<5>2G)1H + 10% 3d5 4d (<3>2H)3I
	-	80326.0	-	42% 3d5 4d (<5>2F)3H + 41% 3d5 4d (<3>2H)3H
	-	81310.0	-	92% 3d5 4d (<5>2F)3G
	-	81504.0	-	98% 3d5 4d (<5>2F)1H
	-	82311.0	-	45% 3d5 4d (<5>2G)3G + 15% 3d5 4d (<3>2H)3G
	-	83076.0	-	52% 3d5 4d (<5>2F)3H + 23% 3d5 4d (<3>2H)3H
	-	90581.0	-	96% 3d5 4d (<3>2D)3G
	-	94603.0	-	100% 3d5 4d (<3>2G)3I
	-	94775.0	-	100% 3d5 4d (<3>2G)1H
	-	95283.0	-	96% 3d5 4d (<3>2G)3H
	-	95373.0	-	94% 3d5 4d (<3>2G)3G
	-	111296.0	-	79% 3d5 4d (<1>2D)3G + 21% 3d5 4d (<5>2D)3G
6	20520.0	20179.0	341.0	100% 3d5 4s (<5>4G)5G
	24200.0	23286.0	914.0	100% 3d4 4s2 <4>3H
	31049.0	30271.0	778.0	100% 3d5 4s (<5>2I)3I
	-	30526.0	-	96% 3d4 4s2 <4>1I + 4% 3d5 4s (<5>2I)1I
	33763.0	33177.0	586.0	95% 3d5 4s (<5>2I)1I + 4% 3d4 4s2 <4>1I
	35934.0	35665.0	269.0	99% 3d5 4s (<3>2H)3H
	-	62571.0	-	100% 3d5 4d (<5>4G)5H
	-	62636.0	-	100% 3d5 4d (<5>4G)5I
	62674.0	62690.0	-16.0	100% 3d5 4d (<5>4G)5G
	-	62964.0	-	100% 3d5 4d (<5>4G)3I
	-	64685.0	-	93% 3d5 4d (<5>4G)3H + 6% 3d5 4d (<5>2I)3H
	-	67129.0	-	100% 3d5 4d (<5>4D)5G
	-	71600.0	-	100% 3d5 4d (<5>2I)3I
	-	71706.0	-	100% 3d5 4d (<5>2I)3K
	-	73430.0	-	81% 3d5 4d (<5>2I)3H + 9% 3d5 4d (<3>4F)3H
	-	74528.0	-	80% 3d5 4d (<5>2I)1I + 12% 3d5 4d (<3>2H)1I
	-	75881.0	-	98% 3d5 4d (<3>4F)5H
	-	75933.0	-	98% 3d5 4d (<3>4F)5G
	-	76467.0	-	61% 3d5 4d (<3>2F)3H + 37% 3d5 4d (<3>4F)3H
	-	77166.0	-	38% 3d5 4d (<3>4F)3H + 32% 3d5 4d (<3>2F)3H
	-	78360.0	-	76% 3d5 4d (<3>2H)3K + 16% 3d5 4d (<5>2G)3I
	-	78414.0	-	82% 3d5 4d (<3>2H)3I + 16% 3d5 4d (<5>2G)3H

	-	78795.0	-	30% 3d5 4d	(<5>2G)3H + 26% 3d5 4d (<5>2G)3I
	-	78850.0	-	57% 3d5 4d	(<5>2G)3I + 18% 3d5 4d (<3>2H)3K
	-	79025.0	-	35% 3d5 4d	(<5>2G)1I + 29% 3d5 4d (<5>2G)3H
	-	80384.0	-	42% 3d5 4d	(<5>2F)3H + 40% 3d5 4d (<3>2H)3H
	-	82935.0	-	52% 3d5 4d	(<5>2F)3H + 21% 3d5 4d (<3>2H)3H
	-	83321.0	-	43% 3d5 4d	(<3>2H)1I + 28% 3d5 4d (<5>2G)1I
	-	*94603.0*	-	*100% 3d5 4d*	*(<3>2G)3I*
	-	95266.0	-	99% 3d5 4d	(<3>2G)3H
	-	96049.0	-	97% 3d5 4d	(<3>2G)1I
7	*31048.0*	*30284.0*	*764.0*	*100% 3d5 4s*	*(<5>2I)3I*
	-	62571.0	-	100% 3d5 4d	(<5>4G)5H
	-	62639.0	-	100% 3d5 4d	(<5>4G)5I
	-	62962.0	-	100% 3d5 4d	(<5>4G)3I
	-	71608.0	-	99% 3d5 4d	(<5>2I)3I
	-	71617.0	-	99% 3d5 4d	(<5>2I)3L
	-	71717.0	-	99% 3d5 4d	(<5>2I)3K
	-	71808.0	-	99% 3d5 4d	(<5>2I)1K
	-	75874.0	-	99% 3d5 4d	(<3>4F)5H
	-	78367.0	-	57% 3d5 4d	(<3>2H)3K + 27% 3d5 4d (<5>2G)3I
	-	78513.0	-	93% 3d5 4d	(<3>2H)3I + 7% 3d5 4d (<3>2H)3K
	-	78612.0	-	66% 3d5 4d	(<3>2H)1K + 26% 3d5 4d (<3>2H)3K
	-	78951.0	-	65% 3d5 4d	(<5>2G)3I + 23% 3d5 4d (<3>2H)1K
	-	94602.0	-	100% 3d5 4d	(<3>2G)3I
8	-	62639.0	-	100% 3d5 4d	(<5>4G)5I
	-	71628.0	-	100% 3d5 4d	(<5>2I)3L
	-	71730.0	-	100% 3d5 4d	(<5>2I)3K
	-	71808.0	-	100% 3d5 4d	(<5>2I)1L
	-	78518.0	-	100% 3d5 4d	(<3>2H)3K
9	-	71642.0	-	100% 3d5 4d	(<5>2I)3L

Table II.

Observed and least squares fitted energy levels of odd parity configurations of Cr I in cm^{-1}:

J	E(obs)	E(LSF)	diff.	LS-composition.
0	24971.0	24596.0	375.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	33338.0	32673.0	665.0	43% 3d4 4s 4p ((<4>5D)6D)5D + 41% 3d4 4s 4p ((<4>5D)4D)5D
	33763.0	33127.0	636.0	83% 3d4 4s 4p ((<4>5D)4D)3P + 8% 3d4 4s 4p ((<4>5D)6D)5D
	42218.0	42478.0	-260.0	42% 3d4 4s 4p ((<4>3P)4P)5D + 26% 3d4 4s 4p ((<2>3P)4P)5D
	-	44218.0	-	33% 3d4 4s 4p ((<4>5D)4D)5D + 28% 3d4 4s 4p ((<4>5D)6D)5D
	45723.0	45642.0	81.0	53% 3d4 4s 4p ((<4>3F)4F)5D + 16% 3d4 4s 4p ((<2>3F)4F)5D
	46081.0	47015.0	-934.0	43% 3d5 4p (<3>4P)3P + 17% 3d4 4s 4p ((<4>3P)4P)3P
	47788.0	47834.0	-46.0	67% 3d5 4p (<3>4P)5D + 9% 3d4 4s 4p ((<4>5D)6D)5D
	48226.0	48176.0	50.0	39% 3d5 4p (<3>4P)3P + 17% 3d4 4s 4p ((<4>3P)2P)3P
	-	49269.0	-	43% 3d4 4s 4p ((<4>3P)2P)1S + 42% 3d4 4s 4p ((<2>3P)2P)1S
	50661.0	50585.0	76.0	73% 3d5 4p (<5>4D)5D + 8% 3d4 4s 4p ((<4>5D)4D)5D
	51177.0	51394.0	-217.0	80% 3d5 4p (<5>4D)3P + 6% 3d5 4p (<3>4P)3P
	52000.0	52362.0	-362.0	97% 3d4 4s 4p ((<4>3D)4D)5D
	-	54967.0	-	22% 3d5 4p (<5>2D)3P + 22% 3d4 4s 4p ((<4>3D)2D)3P
	56803.0	57438.0	-635.0	28% 3d4 4s 4p ((<4>3D)4D)3P + 26% 3d4 4s 4p ((<4>3D)2D)3P
	57155.0	57590.0	-435.0	40% 3d4 4s 4p ((<4>1S)2S)3P + 24% 3d5 4p (<5>2D)3P
	60238.0	59250.0	988.0	90% 3d5 4p (<3>4F)5D
	61388.0	61123.0	265.0	67% 3d4 4s 4p ((<4>1D)2D)3P + 17% 3d4 4s 4p ((<2>1D)2D)3P
	-	63807.0	-	28% 3d4 4s 4p ((<4>3P)4P)3P + 20% 3d4 4s 4p ((<4>3P)2P)3P
	-	67560.0	-	73% 3d5 4p (<5>2S)3P + 9% 3d4 4s 4p ((<4>3D)2D)3P
	-	68990.0	-	36% 3d4 4s 4p ((<2>3P)4P)5D + 33% 3d4 4s 4p ((<2>3F)4F)5D
	-	70784.0	-	32% 3d5 4p (<3>2D)3P + 28% 3d4 4s 4p ((<4>3D)2D)3P
	-	71551.0	-	43% 3d4 4s 4p ((<2>3F)4F)5D + 24% 3d4 4s 4p ((<2>3P)4P)5D
	-	73548.0	-	29% 3d4 4s 4p ((<2>3P)2P)3P + 17% 3d4 4s 4p ((<4>3P)2P)3P
	-	74660.0	-	54% 3d5 4p (<3>2D)3P + 11% 3d4 4s 4p ((<2>3P)2P)3P
	-	76477.0	-	47% 3d4 4s 4p ((<2>3P)2P)1S + 47% 3d4 4s 4p ((<4>3P)2P)1S
	-	85676.0	-	33% 3d4 4s 4p ((<2>3P)4P)3P + 23% 3d5 4p (<3>2P)3P
	-	89345.0	-	59% 3d5 4p (<3>2P)3P + 18% 3d5 4p (<1>2D)3P
	-	89948.0	-	94% 3d5 4p (<3>2P)1S
	-	91233.0	-	70% 3d4 4s 4p ((<2>1D)2D)3P + 17% 3d4 4s 4p ((<4>1D)2D)3P
	-	97603.0	-	51% 3d5 4p (<1>2D)3P + 17% 3d5 4p (<5>2D)3P
	-	111628.0	-	76% 3d4 4s 4p ((<0>1S)2S)3P + 22% 3d4 4s 4p ((<4>1S)2S)3P
1	25011.0	24632.0	379.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	26802.0	25934.0	868.0	95% 3d5 4p (<5>6S)5P
	27300.0	26416.0	884.0	100% 3d4 4s 4p ((<4>5D)6D)7D
	29421.0	29320.0	101.0	60% 3d4 4s 4p ((<4>5D)6D)5P + 38% 3d4 4s 4p ((<4>5D)4D)5P
	30787.0	30366.0	421.0	53% 3d4 4s 4p ((<4>5D)6D)5F + 45% 3d4 4s 4p ((<4>5D)4D)5F
	33424.0	32746.0	678.0	47% 3d4 4s 4p ((<4>5D)6D)5D + 44% 3d4 4s 4p ((<4>5D)4D)5D
	33897.0	33265.0	632.0	90% 3d4 4s 4p ((<4>5D)4D)3P + 4% 3d4 4s 4p ((<4>5D)6D)5D
	-	37277.0	-	99% 3d4 4s 4p ((<4>5D)4D)3D
	41289.0	42049.0	-760.0	43% 3d5 4p (<5>4G)5F + 34% 3d4 4s 4p ((<4>5D)4D)5F
	42293.0	42556.0	-263.0	41% 3d4 4s 4p ((<4>3P)4P)5D + 25% 3d4 4s 4p ((<2>3P)4P)5D
	-	43720.0	-	30% 3d4 4s 4p ((<4>5D)4D)5P + 29% 3d4 4s 4p ((<4>3P)4P)5P
	44667.0	44274.0	393.0	32% 3d4 4s 4p ((<4>5D)4D)5D + 27% 3d4 4s 4p ((<4>5D)6D)5D
	45202.0	44663.0	539.0	67% 3d4 4s 4p ((<4>3F)4F)5F + 14% 3d4 4s 4p ((<2>3F)4F)5F
	45719.0	44917.0	802.0	30% 3d4 4s 4p ((<4>3P)4P)5P + 20% 3d4 4s 4p ((<4>5D)4D)5P
	46077.0	45668.0	409.0	51% 3d4 4s 4p ((<4>3F)4F)5D + 16% 3d4 4s 4p ((<4>3P)4P)5D
	46298.0	46501.0	-203.0	56% 3d4 4s 4p ((<4>3G)4G)5F + 23% 3d5 4p (<5>4D)5F
	46678.0	46982.0	-304.0	39% 3d5 4p (<3>4P)3P + 13% 3d4 4s 4p ((<4>3P)4P)3P
	47022.0	47406.0	-384.0	14% 3d4 4s 4p ((<4>3P)2P)3S + 12% 3d4 4s 4p ((<2>3P)2P)3S
	47878.0	47491.0	387.0	49% 3d5 4p (<3>4P)5P + 30% 3d5 4p (<5>4D)5P
	47077.0	47496.0	-419.0	21% 3d5 4p (<3>4P)3D + 11% 3d4 4s 4p ((<4>3P)2P)3D
	47088.0	47640.0	-552.0	34% 3d5 4p (<5>4G)5F + 20% 3d4 4s 4p ((<4>5D)6D)5F
	48210.0	47861.0	349.0	67% 3d5 4p (<3>4P)5D + 9% 3d4 4s 4p ((<4>5D)6D)5D
	48331.0	48127.0	204.0	30% 3d4 4s 4p ((<4>3F)2F)3D + 30% 3d4 4s 4p ((<4>3F)4F)3D
	48840.0	48376.0	464.0	28% 3d5 4p (<3>4P)3P + 24% 3d4 4s 4p ((<4>3P)2P)3P
	49477.0	48997.0	480.0	43% 3d5 4p (<3>4P)3D + 14% 3d4 4s 4p ((<4>3P)2P)3D
	49589.0	49249.0	340.0	63% 3d5 4p (<5>4D)5F + 19% 3d4 4s 4p ((<4>3G)4G)5F
	50019.0	50003.0	16.0	59% 3d4 4s 4p ((<4>3P)2P)1P + 29% 3d4 4s 4p ((<2>3P)2P)1P
	50106.0	50079.0	27.0	44% 3d5 4p (<5>4D)5P + 29% 3d5 4p (<3>4P)5P
	-	50151.0	-	75% 3d5 4p (<3>4P)3S + 8% 3d4 4s 4p ((<2>3P)4P)3S
	-	50211.0	-	77% 3d5 4p (<5>4D)3D + 8% 3d5 4p (<3>4P)3D
	50663.0	50598.0	65.0	72% 3d5 4p (<5>4D)5D + 8% 3d4 4s 4p ((<4>5D)4D)5D
	51247.0	51492.0	-245.0	77% 3d5 4p (<5>4D)3P + 7% 3d5 4p (<3>4P)3P
	52003.0	52358.0	-355.0	96% 3d4 4s 4p ((<4>3D)4D)5D
	53012.0	52960.0	52.0	89% 3d4 4s 4p ((<4>3D)4D)5F + 5% 3d5 4p (<5>4D)5F
	-	53841.0	-	82% 3d4 4s 4p ((<4>3D)4D)5P + 15% 3d5 4p (<5>4D)5P
	54957.0	54963.0	-6.0	22% 3d4 4s 4p ((<4>3D)2D)3P + 18% 3d4 4s 4p ((<4>1S)2S)3P
	-	55448.0	-	30% 3d5 4p (<5>2D)3D + 26% 3d4 4s 4p ((<4>3D)2D)3D
	56723.0	56414.0	309.0	47% 3d5 4p (<3>2F)3D + 11% 3d5 4p (<5>2D)1P
	57097.0	56969.0	128.0	35% 3d4 4s 4p ((<4>3D)2D)1P + 24% 3d5 4p (<5>2D)1P
	57133.0	57396.0	-263.0	23% 3d4 4s 4p ((<4>3D)2D)3P + 22% 3d4 4s 4p ((<4>3D)4D)3P
	-	57606.0	-	34% 3d4 4s 4p ((<4>1S)2S)3P + 29% 3d5 4p (<5>2D)3P
	-	58194.0	-	63% 3d5 4p (<3>4F)5F + 11% 3d4 4s 4p ((<4>1D)2D)3D
	58725.0	58299.0	426.0	31% 3d4 4s 4p ((<4>1D)2D)3D + 29% 3d5 4p (<3>4F)5F

	-	59247.0	-	89% 3d5 4p (<3>4F)5D
	-	59322.0	-	22% 3d5 4p (<3>4F)3D + 15% 3d4 4s 4p ((<4>1D)2D)3D
	60084.0	59676.0	408.0	32% 3d4 4s 4p ((<4>3D)2D)1P + 25% 3d5 4p (<5>2D)1P
	60287.0	59994.0	293.0	63% 3d5 4p (<3>4F)3D + 7% 3d4 4s 4p ((<4>3D)2D)1P
	61066.0	61180.0	-114.0	66% 3d4 4s 4p ((<4>1D)2D)3P + 16% 3d4 4s 4p ((<2>1D)2D)3P
	61527.0	61510.0	17.0	34% 3d5 4p (<5>2F)3D + 18% 3d4 4s 4p ((<4>3P)4P)3D
	-	63331.0	-	20% 3d4 4s 4p ((<4>3P)2P)3S + 17% 3d4 4s 4p ((<4>3P)4P)3S
	-	63650.0	-	24% 3d4 4s 4p ((<4>3F)4F)3D + 16% 3d4 4s 4p ((<4>3F)2F)3D
	-	64182.0	-	20% 3d4 4s 4p ((<4>3P)4P)3P + 14% 3d4 4s 4p ((<4>3P)2P)3P
	-	66183.0	-	77% 3d4 4s 4p ((<4>1F)2F)3D
	-	66581.0	-	42% 3d5 4p (<5>2F)3D + 13% 3d4 4s 4p ((<4>1F)2F)3D
	-	67595.0	-	72% 3d5 4p (<5>2S)3P + 9% 3d4 4s 4p ((<4>3D)2D)3P
	-	67965.0	-	80% 3d4 4s 4p ((<2>3F)4F)5F + 17% 3d4 4s 4p ((<4>3F)4F)5F
	-	68185.0	-	83% 3d5 4p (<5>2S)1P + 8% 3d4 4s 4p ((<4>1D)2D)1P
	-	68794.0	-	51% 3d4 4s 4p ((<2>3P)4P)5P + 29% 3d4 4s 4p ((<4>3P)4P)5P
	-	68999.0	-	29% 3d4 4s 4p ((<2>3P)4P)5D + 27% 3d4 4s 4p ((<2>3F)4F)5D
	-	69905.0	-	36% 3d4 4s 4p ((<4>3D)4D)3D + 30% 3d5 4p (<3>2D)3D
	-	70742.0	-	32% 3d5 4p (<3>2D)3P + 28% 3d4 4s 4p ((<4>3D)2D)3P
	-	71472.0	-	23% 3d4 4s 4p ((<2>3F)4F)5D + 11% 3d4 4s 4p ((<2>3P)4P)5D
	-	71585.0	-	21% 3d4 4s 4p ((<2>3F)4F)5D + 13% 3d4 4s 4p ((<2>3P)4P)5D
	-	71642.0	-	63% 3d5 4p (<3>2D)1P + 21% 3d4 4s 4p ((<4>1S)2S)1P
	-	73503.0	-	29% 3d4 4s 4p ((<2>3P)2P)3P + 17% 3d4 4s 4p ((<4>3P)2P)3P
	-	74305.0	-	35% 3d4 4s 4p ((<4>1S)2S)1P + 23% 3d4 4s 4p ((<4>1D)2D)1P
	-	74534.0	-	30% 3d5 4p (<3>2D)3D + 16% 3d5 4p (<3>2D)3P
	-	74586.0	-	25% 3d5 4p (<3>2D)3D + 15% 3d4 4s 4p ((<2>3P)2P)3S
	-	74704.0	-	34% 3d5 4p (<3>2D)3P + 8% 3d4 4s 4p ((<2>3P)2P)3P
	-	75907.0	-	56% 3d4 4s 4p ((<2>3P)2P)1P + 29% 3d4 4s 4p ((<4>3P)2P)1P
	-	76332.0	-	28% 3d4 4s 4p ((<2>3F)2F)3D + 17% 3d4 4s 4p ((<2>3F)4F)3D
	-	80042.0	-	39% 3d4 4s 4p ((<4>1D)2D)1P + 23% 3d5 4p (<3>2D)1P
	-	85571.0	-	33% 3d4 4s 4p ((<2>3P)4P)3P + 22% 3d5 4p (<3>2P)3P
	-	86595.0	-	24% 3d4 4s 4p ((<2>3F)4F)3D + 20% 3d4 4s 4p ((<2>3F)2F)3D
	-	87813.0	-	24% 3d4 4s 4p ((<2>3P)2P)3S + 22% 3d4 4s 4p ((<2>3P)4P)3S
	-	88004.0	-	24% 3d5 4p (<3>2P)3D + 21% 3d4 4s 4p ((<2>3P)4P)3D
	-	89406.0	-	59% 3d5 4p (<3>2P)3P + 17% 3d5 4p (<1>2D)3P
	-	90930.0	-	62% 3d5 4p (<3>2P)3D + 10% 3d5 4p (<1>2D)3D
	-	91185.0	-	69% 3d4 4s 4p ((<2>1D)2D)3P + 17% 3d4 4s 4p ((<4>1D)2D)3P
	-	91497.0	-	86% 3d5 4p (<3>2P)1P
	-	92328.0	-	77% 3d5 4p (<3>2P)3S + 10% 3d4 4s 4p ((<4>3P)4P)3S
	-	94515.0	-	74% 3d4 4s 4p ((<2>1D)2D)3D + 24% 3d4 4s 4p ((<4>1D)2D)3D
	-	96753.0	-	62% 3d5 4p (<1>2D)3D + 19% 3d5 4p (<5>2D)3D
	-	97337.0	-	65% 3d5 4p (<1>2D)1P + 20% 3d5 4p (<5>2D)1P
	-	97541.0	-	49% 3d5 4p (<1>2D)3P + 16% 3d5 4p (<5>2D)3P
	-	108252.0	-	70% 3d4 4s 4p ((<2>1D)2D)1P + 18% 3d4 4s 4p ((<4>1D)2D)1P
	-	111696.0	-	76% 3d4 4s 4p ((<0>1S)2S)3P + 22% 3d4 4s 4p ((<4>1S)2S)3P
	-	127615.0	-	76% 3d4 4s 4p ((<0>1S)2S)1P + 21% 3d4 4s 4p ((<4>1S)2S)1P
2	23305.0	22641.0	664.0	82% 3d5 4p (<5>6S)7P + 18% 3d4 4s 4p ((<4>5D)6D)7P
	25089.0	24703.0	386.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	26796.0	25864.0	932.0	63% 3d4 4s 4p ((<4>5D)6D)7P + 22% 3d5 4p (<5>6S)5P
	26796.0	25940.0	856.0	73% 3d5 4p (<5>6S)5P + 18% 3d4 4s 4p ((<4>5D)6D)7P
	27382.0	26496.0	886.0	100% 3d4 4s 4p ((<4>5D)6D)7D
	29585.0	29487.0	98.0	60% 3d4 4s 4p ((<4>5D)6D)5P + 38% 3d4 4s 4p ((<4>5D)4D)5P
	30859.0	30439.0	420.0	53% 3d4 4s 4p ((<4>5D)6D)5F + 45% 3d4 4s 4p ((<4>5D)4D)5F
	33542.0	32858.0	684.0	50% 3d4 4s 4p ((<4>5D)6D)5D + 47% 3d4 4s 4p ((<4>5D)4D)5D
	34190.0	33559.0	631.0	96% 3d4 4s 4p ((<4>5D)4D)3P
	-	34751.0	-	97% 3d4 4s 4p ((<4>5D)4D)3F
	-	37418.0	-	99% 3d4 4s 4p ((<4>5D)4D)3D
	40971.0	41956.0	-985.0	56% 3d5 4p (<5>4G)5G + 29% 3d4 4s 4p ((<4>3H)4H)5G
	41409.0	42096.0	-687.0	44% 3d5 4p (<5>4G)5F + 34% 3d4 4s 4p ((<4>5D)4D)5F
	42439.0	42711.0	-272.0	39% 3d4 4s 4p ((<4>3P)4P)5D + 24% 3d4 4s 4p ((<2>3P)4P)5D
	43125.0	43680.0	-555.0	20% 3d5 4p (<3>4P)5S + 19% 3d4 4s 4p ((<4>3P)4P)5S
	44300.0	43966.0	334.0	20% 3d5 4p (<3>4P)5S + 20% 3d4 4s 4p ((<4>5D)4D)5P
	-	43983.0	-	55% 3d4 4s 4p ((<4>3F)4F)5G + 19% 3d4 4s 4p ((<2>3F)4F)5G
	44875.0	44381.0	494.0	30% 3d4 4s 4p ((<4>5D)4D)5D + 26% 3d4 4s 4p ((<4>5D)6D)5D
	-	44687.0	-	65% 3d4 4s 4p ((<4>3F)4F)5F + 14% 3d4 4s 4p ((<2>3F)4F)5F
	45225.0	44887.0	338.0	54% 3d4 4s 4p ((<4>3H)4H)5G + 21% 3d5 4p (<5>4G)5G
	45966.0	45121.0	845.0	88% 3d5 4p (<5>4G)3F
	45734.0	45148.0	586.0	31% 3d4 4s 4p ((<4>3P)4P)5P + 19% 3d4 4s 4p ((<2>3P)4P)5P
	46109.0	45727.0	382.0	47% 3d4 4s 4p ((<4>3F)4F)5D + 17% 3d4 4s 4p ((<4>3P)4P)5D
	46349.0	46556.0	-207.0	54% 3d4 4s 4p ((<4>3G)4G)5F + 24% 3d5 4p (<5>4D)5F
	46677.0	47018.0	-341.0	52% 3d5 4p (<3>4P)3P + 11% 3d4 4s 4p ((<4>3P)4P)3P
	46968.0	47387.0	-419.0	44% 3d5 4p (<3>4P)5P + 30% 3d5 4p (<5>4D)5P
	47786.0	47542.0	244.0	38% 3d5 4p (<3>4P)3D + 14% 3d4 4s 4p ((<4>3P)2P)3D
	47047.0	47671.0	-624.0	33% 3d5 4p (<5>4G)5F + 20% 3d4 4s 4p ((<4>5D)6D)5F
	47918.0	47800.0	118.0	72% 3d4 4s 4p ((<4>3G)4G)5G + 10% 3d5 4p (<5>4G)5G
	-	47901.0	-	64% 3d5 4p (<3>4P)5D + 8% 3d4 4s 4p ((<4>5D)6D)5D
	-	48123.0	-	30% 3d4 4s 4p ((<4>3F)2F)3D + 29% 3d4 4s 4p ((<4>3F)4F)3D
	-	48312.0	-	32% 3d5 4p (<3>4P)5S + 12% 3d4 4s 4p ((<4>3P)2P)3P
	48459.0	48574.0	-115.0	25% 3d5 4p (<3>4P)5S + 14% 3d4 4s 4p ((<4>3P)2P)3P
	48218.0	48657.0	-439.0	28% 3d4 4s 4p ((<4>3F)2F)3F + 23% 3d4 4s 4p ((<4>3F)4F)3F
	49028.0	49070.0	-42.0	31% 3d5 4p (<3>4P)3D + 17% 3d4 4s 4p ((<4>3P)2P)3D
	49467.0	49274.0	193.0	62% 3d5 4p (<5>4D)5F + 19% 3d4 4s 4p ((<4>3G)4G)5F
	49586.0	49613.0	-27.0	36% 3d4 4s 4p ((<4>3F)2F)1D + 12% 3d4 4s 4p ((<4>3G)2G)3F
	49598.0	49813.0	-215.0	24% 3d4 4s 4p ((<4>3F)2F)1D + 18% 3d4 4s 4p ((<4>3G)2G)3F
	49653.0	50183.0	-530.0	34% 3d5 4p (<5>4D)5P + 23% 3d5 4p (<3>4P)5P
	49823.0	50264.0	-441.0	66% 3d5 4p (<5>4D)3D + 9% 3d5 4p (<3>4P)3D

	50058.0	50613.0	-555.0	65% 3d5 4p (<5>4D)5D + 8% 3d4 4s 4p ((<4>5D)4D)5D
	50655.0	50761.0	-106.0	65% 3d5 4p (<5>4D)3F + 17% 3d4 4s 4p ((<4>3G)4G)3F
	50184.0	50877.0	-693.0	56% 3d4 4s 4p ((<4>3P)2P)1D + 37% 3d4 4s 4p ((<2>3P)2P)1D
	50890.0	51581.0	-691.0	77% 3d5 4p (<5>4D)3P + 10% 3d5 4p (<3>4P)3P
	51287.0	52355.0	-1068.0	95% 3d4 4s 4p ((<4>3D)4D)5D
	52012.0	52975.0	-963.0	88% 3d4 4s 4p ((<4>3D)4D)5F + 5% 3d5 4p (<5>4D)5F
	53038.0	53230.0	-192.0	55% 3d4 4s 4p ((<4>1G)2G)3F + 26% 3d4 4s 4p ((<2>1G)2G)3F
	-	53745.0	-	81% 3d4 4s 4p ((<4>3D)4D)5P + 16% 3d5 4p (<5>4D)5P
	-	54904.0	-	16% 3d5 4p (<5>2D)3P + 14% 3d4 4s 4p ((<4>3D)2D)3P
	54993.0	55016.0	-23.0	10% 3d5 4p (<5>2D)3F + 10% 3d5 4p (<5>2D)1D
	-	55263.0	-	17% 3d5 4p (<5>2D)1D + 15% 3d5 4p (<5>2D)3F
	55153.0	55446.0	-293.0	26% 3d5 4p (<5>2D)3D + 24% 3d4 4s 4p ((<4>3D)2D)3D
	56155.0	56553.0	-398.0	57% 3d5 4p (<3>2F)3D + 5% 3d4 4s 4p ((<4>3P)2P)3D
	56592.0	57153.0	-561.0	32% 3d4 4s 4p ((<4>3D)2D)3F + 23% 3d4 4s 4p ((<4>3D)4D)3F
	57088.0	57245.0	-157.0	20% 3d4 4s 4p ((<4>3D)2D)3P + 19% 3d4 4s 4p ((<4>3D)4D)3P
	57101.0	57589.0	-488.0	30% 3d4 4s 4p ((<4>1S)2S)3P + 21% 3d5 4p (<5>2D)3P
	57221.0	57668.0	-447.0	47% 3d5 4p (<3>4F)5G + 16% 3d5 4p (<3>2F)3F
	-	58009.0	-	45% 3d5 4p (<3>4F)5G + 15% 3d5 4p (<3>2F)3F
	-	58218.0	-	87% 3d5 4p (<3>4F)5F
	58163.0	58378.0	-215.0	40% 3d4 4s 4p ((<4>1D)2D)3D + 13% 3d4 4s 4p ((<4>3D)2D)3D
	58860.0	59095.0	-235.0	34% 3d5 4p (<3>2F)1D + 21% 3d4 4s 4p ((<4>3D)2D)1D
	-	59159.0	-	39% 3d4 4s 4p ((<4>1D)2D)3F + 19% 3d5 4p (<5>2G)3F
	-	59251.0	-	76% 3d5 4p (<3>4F)5D + 5% 3d4 4s 4p ((<4>1D)2D)3F
	59358.0	59336.0	22.0	12% 3d5 4p (<3>4F)3F + 11% 3d4 4s 4p ((<4>1D)2D)3D
	-	59485.0	-	47% 3d5 4p (<3>4F)3F + 6% 3d5 4p (<5>2D)3F
	60253.0	59901.0	352.0	70% 3d5 4p (<3>4F)3D + 6% 3d4 4s 4p ((<4>1D)2D)3D
	60373.0	60772.0	-399.0	40% 3d4 4s 4p ((<4>3D)2D)1D + 24% 3d5 4p (<5>2D)1D
	60778.0	60960.0	-182.0	37% 3d5 4p (<5>2G)3F + 10% 3d4 4s 4p ((<4>3F)4F)3F
	60630.0	61290.0	-660.0	64% 3d4 4s 4p ((<4>1D)2D)3P + 16% 3d4 4s 4p ((<2>1D)2D)3P
	61108.0	61640.0	-532.0	36% 3d5 4p (<5>2F)3D + 18% 3d4 4s 4p ((<4>3P)4P)3D
	61676.0	61995.0	-319.0	38% 3d5 4p (<5>2F)3F + 36% 3d4 4s 4p ((<4>1F)2F)3F
	-	63729.0	-	24% 3d4 4s 4p ((<4>3F)4F)3D + 16% 3d4 4s 4p ((<4>3F)2F)3D
	-	63780.0	-	86% 3d5 4p (<5>2F)1D
	-	64262.0	-	26% 3d4 4s 4p ((<4>3P)4P)3P + 18% 3d4 4s 4p ((<4>3P)2P)3P
	-	64866.0	-	45% 3d4 4s 4p ((<4>1F)2F)3F + 27% 3d5 4p (<5>2F)3F
	-	65295.0	-	22% 3d4 4s 4p ((<4>3F)4F)3F + 22% 3d5 4p (<5>2G)3F
	-	66114.0	-	82% 3d4 4s 4p ((<4>1F)2F)3D
	-	66446.0	-	30% 3d4 4s 4p ((<4>3G)4G)3F + 23% 3d4 4s 4p ((<4>3G)2G)3F
	-	66684.0	-	40% 3d5 4p (<5>2F)3D + 6% 3d4 4s 4p ((<4>3P)4P)3D
	-	67668.0	-	70% 3d5 4p (<5>2S)3P + 10% 3d4 4s 4p ((<4>3D)2D)3P
	-	67973.0	-	80% 3d4 4s 4p ((<2>3F)4F)5F + 17% 3d4 4s 4p ((<4>3F)4F)5F
	-	68664.0	-	49% 3d4 4s 4p ((<2>3P)4P)5P + 27% 3d4 4s 4p ((<4>3P)4P)5P
	-	68963.0	-	28% 3d4 4s 4p ((<2>3P)4P)5D + 26% 3d4 4s 4p ((<2>3F)4F)5D
	-	69015.0	-	76% 3d4 4s 4p ((<2>3F)4F)5G + 23% 3d4 4s 4p ((<4>3F)4F)5G
	-	69877.0	-	35% 3d4 4s 4p ((<4>3D)4D)3D + 29% 3d5 4p (<3>2D)3D
	-	70432.0	-	43% 3d4 4s 4p ((<4>3D)4D)3F + 29% 3d4 4s 4p ((<4>3D)2D)3F
	-	70655.0	-	31% 3d5 4p (<3>2D)3P + 27% 3d4 4s 4p ((<4>3D)2D)3P
	-	70927.0	-	55% 3d4 4s 4p ((<2>3P)4P)5S + 41% 3d4 4s 4p ((<4>3P)4P)5S
	-	71399.0	-	23% 3d4 4s 4p ((<2>3F)4F)5D + 10% 3d4 4s 4p ((<2>3P)2P)3D
	-	71538.0	-	14% 3d4 4s 4p ((<2>3F)4F)5D + 13% 3d4 4s 4p ((<2>3F)2F)3F
	-	71595.0	-	22% 3d4 4s 4p ((<2>3F)2F)3F + 17% 3d4 4s 4p ((<2>3F)4F)3F
	-	72679.0	-	38% 3d4 4s 4p ((<2>3P)2P)1D + 25% 3d4 4s 4p ((<2>3F)2F)1D
	-	72901.0	-	61% 3d5 4p (<3>2D)1D + 20% 3d4 4s 4p ((<4>1D)2D)1D
	-	73180.0	-	79% 3d5 4p (<3>2D)3F + 4% 3d5 4p (<3>2D)1D
	-	73491.0	-	30% 3d4 4s 4p ((<2>3P)2P)3P + 17% 3d4 4s 4p ((<4>3P)2P)3P
	-	74537.0	-	54% 3d5 4p (<3>2D)3D + 13% 3d4 4s 4p ((<4>3D)4D)3D
	-	74646.0	-	47% 3d5 4p (<3>2D)3P + 10% 3d5 4p (<3>2D)3D
	-	76253.0	-	29% 3d4 4s 4p ((<2>3F)2F)3D + 17% 3d4 4s 4p ((<2>3F)4F)3D
	-	76415.0	-	47% 3d4 4s 4p ((<4>1D)2D)1D + 25% 3d5 4p (<3>2D)1D
	-	77224.0	-	59% 3d4 4s 4p ((<2>1G)2G)3F + 25% 3d4 4s 4p ((<4>1G)2G)3F
	-	78391.0	-	74% 3d5 4p (<3>2G)3F + 8% 3d4 4s 4p ((<2>3F)2F)3F
	-	78688.0	-	48% 3d4 4s 4p ((<2>3F)2F)1D + 19% 3d4 4s 4p ((<2>3P)2P)1D
	-	82278.0	-	84% 3d4 4s 4p ((<4>1F)2F)1D + 6% 3d5 4p (<3>2P)1D
	-	85431.0	-	33% 3d4 4s 4p ((<2>3P)4P)3P + 21% 3d5 4p (<3>2P)3P
	-	86042.0	-	42% 3d4 4s 4p ((<2>3F)4F)3F + 29% 3d4 4s 4p ((<2>3F)2F)3F
	-	86520.0	-	22% 3d4 4s 4p ((<2>3F)4F)3D + 19% 3d4 4s 4p ((<2>3F)2F)3D
	-	87903.0	-	24% 3d5 4p (<3>2P)3D + 19% 3d4 4s 4p ((<2>3P)4P)3D
	-	89479.0	-	61% 3d5 4p (<3>2P)3P + 16% 3d5 4p (<1>2D)3P
	-	90722.0	-	67% 3d5 4p (<3>2P)1D + 11% 3d5 4p (<1>2D)1D
	-	90945.0	-	58% 3d5 4p (<3>2P)3D + 9% 3d5 4p (<3>2P)1D
	-	91114.0	-	69% 3d4 4s 4p ((<2>1D)2D)3P + 17% 3d4 4s 4p ((<4>1D)2D)3P
	-	92516.0	-	74% 3d4 4s 4p ((<2>1D)2D)3F + 20% 3d4 4s 4p ((<4>1D)2D)3F
	-	94544.0	-	74% 3d4 4s 4p ((<2>1D)2D)3D + 24% 3d4 4s 4p ((<4>1D)2D)3D
	-	95453.0	-	70% 3d5 4p (<1>2D)3F + 22% 3d5 4p (<5>2D)3F
	-	96001.0	-	60% 3d5 4p (<1>2D)1D + 20% 3d5 4p (<5>2D)1D
	-	96802.0	-	62% 3d5 4p (<1>2D)3D + 19% 3d5 4p (<5>2D)3D
	-	97393.0	-	51% 3d5 4p (<1>2D)3P + 17% 3d5 4p (<5>2D)3P
	-	110719.0	-	73% 3d4 4s 4p ((<2>1D)2D)1D + 23% 3d4 4s 4p ((<4>1D)2D)1D
	-	111832.0	-	76% 3d4 4s 4p ((<0>1S)2S)3P + 22% 3d4 4s 4p ((<4>1S)2S)3P
3	23386.0	22701.0	685.0	83% 3d5 4p (<5>6S)7P + 17% 3d4 4s 4p ((<4>5D)6D)7P
	25206.0	24809.0	397.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	-	25893.0	-	86% 3d5 4p (<5>6S)5P + 8% 3d4 4s 4p ((<4>5D)6D)7P
	26788.0	26019.0	769.0	74% 3d4 4s 4p ((<4>5D)6D)7P + 16% 3d5 4p (<5>6S)7P
	-	26613.0	-	99% 3d4 4s 4p ((<4>5D)6D)7D
	29825.0	29734.0	91.0	59% 3d4 4s 4p ((<4>5D)6D)5P + 38% 3d4 4s 4p ((<4>5D)4D)5P

30965.0	30548.0	417.0	53% 3d4 4s 4p ((<4>5D)6D)5F + 44% 3d4 4s 4p ((<4>5D)4D)5F
33672.0	32993.0	679.0	51% 3d4 4s 4p ((<4>5D)6D)5D + 48% 3d4 4s 4p ((<4>5D)4D)5D
-	34903.0	-	97% 3d4 4s 4p ((<4>5D)4D)3F
-	37609.0	-	99% 3d4 4s 4p ((<4>5D)4D)3D
41043.0	41147.0	-104.0	81% 3d4 4s 4p ((<4>3H)4H)5H + 10% 3d5 4p (<5>4G)5H
41086.0	41971.0	-885.0	56% 3d5 4p (<5>4G)5G + 29% 3d4 4s 4p ((<4>3H)4H)5G
41575.0	42164.0	-589.0	45% 3d5 4p (<5>4G)5F + 33% 3d4 4s 4p ((<4>5D)4D)5F
42026.0	42937.0	-911.0	37% 3d4 4s 4p ((<4>3P)4P)5D + 22% 3d4 4s 4p ((<2>3P)4P)5D
-	44016.0	-	28% 3d4 4s 4p ((<4>5D)4D)5P + 24% 3d4 4s 4p ((<4>3P)4P)5P
-	44028.0	-	47% 3d4 4s 4p ((<4>3F)4F)5G + 16% 3d4 4s 4p ((<2>3F)4F)5G
44373.0	44076.0	297.0	78% 3d5 4p (<5>4G)5H + 12% 3d4 4s 4p ((<4>3H)4H)5H
-	44515.0	-	29% 3d4 4s 4p ((<4>5D)4D)5D + 25% 3d4 4s 4p ((<4>5D)6D)5D
-	44722.0	-	63% 3d4 4s 4p ((<4>3F)4F)5F + 13% 3d4 4s 4p ((<2>3F)4F)5F
45113.0	44918.0	195.0	52% 3d4 4s 4p ((<4>3H)4H)5G + 21% 3d5 4p (<5>4G)5G
46174.0	45146.0	1028.0	89% 3d5 4p (<5>4G)3F
45255.0	45389.0	-134.0	31% 3d4 4s 4p ((<4>3P)4P)5P + 18% 3d4 4s 4p ((<2>3P)4P)5P
45566.0	45787.0	-221.0	34% 3d4 4s 4p ((<4>3H)2H)3G + 24% 3d4 4s 4p ((<4>3H)4H)3G
46000.0	45830.0	170.0	38% 3d4 4s 4p ((<4>3F)4F)5D + 18% 3d4 4s 4p ((<4>3P)4P)5D
46688.0	46378.0	310.0	67% 3d5 4p (<5>4G)3G + 19% 3d4 4s 4p ((<4>3G)4G)5H
46368.0	46492.0	-124.0	69% 3d4 4s 4p ((<4>3G)4G)5H + 13% 3d5 4p (<5>4G)3G
46847.0	46624.0	223.0	52% 3d4 4s 4p ((<4>3G)4G)5F + 24% 3d5 4p (<5>4D)5F
46879.0	47213.0	-334.0	45% 3d5 4p (<3>4P)5P + 34% 3d5 4p (<5>4D)5P
47048.0	47604.0	-556.0	47% 3d5 4p (<3>4P)3D + 10% 3d4 4s 4p ((<4>3P)2P)3D
47126.0	47719.0	-593.0	32% 3d5 4p (<5>4G)5F + 21% 3d4 4s 4p ((<4>5D)6D)5F
47621.0	47873.0	-252.0	69% 3d4 4s 4p ((<4>3G)4G)5G + 9% 3d5 4p (<5>4G)5G
47814.0	47950.0	-136.0	60% 3d5 4p (<3>4P)5D + 7% 3d4 4s 4p ((<4>5D)6D)5D
47975.0	48146.0	-173.0	31% 3d4 4s 4p ((<4>3F)4F)3D + 31% 3d4 4s 4p ((<4>3F)2F)3D
-	48597.0	-	17% 3d4 4s 4p ((<4>3F)2F)3F + 16% 3d4 4s 4p ((<4>3F)2F)3G
48252.0	48796.0	-544.0	19% 3d4 4s 4p ((<4>3F)2F)3G + 13% 3d4 4s 4p ((<4>3F)2F)3F
49371.0	49200.0	171.0	23% 3d4 4s 4p ((<4>3P)2P)3D + 19% 3d5 4p (<3>4P)3D
49520.0	49310.0	210.0	60% 3d5 4p (<5>4D)5F + 19% 3d4 4s 4p ((<4>3G)4G)5F
49650.0	49780.0	-130.0	30% 3d4 4s 4p ((<4>3G)2G)3F + 21% 3d5 4p (<5>4D)3F
49812.0	50261.0	-449.0	44% 3d5 4p (<5>4D)3D + 11% 3d5 4p (<5>4D)5P
49718.0	50391.0	-673.0	26% 3d5 4p (<5>4D)3D + 20% 3d5 4p (<5>4D)5P
50102.0	50535.0	-433.0	53% 3d4 4s 4p ((<4>3F)2F)1F + 14% 3d4 4s 4p ((<2>3F)2F)1F
50264.0	50628.0	-364.0	50% 3d5 4p (<5>4D)5D + 10% 3d5 4p (<3>4P)5P
50628.0	50801.0	-173.0	60% 3d5 4p (<5>4D)3F + 17% 3d4 4s 4p ((<4>3G)4G)3F
50950.0	51409.0	-459.0	44% 3d4 4s 4p ((<4>3G)2G)3G + 33% 3d4 4s 4p ((<4>3G)4G)3G
-	52075.0	-	71% 3d4 4s 4p ((<4>3G)2G)1F + 19% 3d4 4s 4p ((<4>3F)2F)1F
52032.0	52357.0	-325.0	94% 3d4 4s 4p ((<4>3D)4D)5D
53074.0	52994.0	80.0	87% 3d4 4s 4p ((<4>3D)4D)5F + 5% 3d5 4p (<5>4D)5F
-	53128.0	-	55% 3d4 4s 4p ((<4>1G)2G)3F + 26% 3d4 4s 4p ((<2>1G)2G)3F
-	53598.0	-	81% 3d4 4s 4p ((<4>3D)4D)5P + 16% 3d5 4p (<5>4D)5P
-	54027.0	-	54% 3d4 4s 4p ((<4>1G)2G)3G + 32% 3d4 4s 4p ((<2>1G)2G)3G
55102.0	55159.0	-57.0	22% 3d5 4p (<5>2D)3F + 17% 3d5 4p (<3>2F)3F
55452.0	55419.0	33.0	21% 3d5 4p (<5>2D)3D + 21% 3d4 4s 4p ((<4>3D)2D)3D
56210.0	55922.0	288.0	37% 3d5 4p (<5>2D)1F + 17% 3d5 4p (<3>2F)1F
56986.0	56688.0	298.0	65% 3d5 4p (<3>2F)3D + 5% 3d4 4s 4p ((<4>3P)2P)3D
57187.0	57196.0	-9.0	32% 3d4 4s 4p ((<4>3D)2D)3F + 24% 3d4 4s 4p ((<4>3D)4D)3F
57276.0	57333.0	-57.0	63% 3d5 4p (<3>2F)3G + 11% 3d5 4p (<3>2F)3F
-	57561.0	-	48% 3d5 4p (<3>4F)3G + 9% 3d5 4p (<5>2G)3G
57557.0	57714.0	-157.0	49% 3d5 4p (<3>4F)5G + 15% 3d5 4p (<3>2F)3F
-	58000.0	-	43% 3d5 4p (<3>4F)5G + 15% 3d5 4p (<5>2D)3F
58203.0	58223.0	-20.0	90% 3d5 4p (<3>4F)5F
-	58488.0	-	33% 3d4 4s 4p ((<4>1D)2D)3D + 17% 3d4 4s 4p ((<4>3D)2D)3D
-	58736.0	-	40% 3d5 4p (<3>2H)3G + 9% 3d4 4s 4p ((<4>3H)2H)3G
-	58883.0	-	36% 3d4 4s 4p ((<4>3D)2D)1F + 27% 3d5 4p (<3>2F)1F
59122.0	59156.0	-34.0	29% 3d5 4p (<3>4F)5D + 14% 3d4 4s 4p ((<4>1D)2D)3F
59417.0	59252.0	165.0	13% 3d4 4s 4p ((<4>3D)2D)1F + 12% 3d5 4p (<5>2D)3D
-	59293.0	-	49% 3d5 4p (<3>4F)5D + 21% 3d4 4s 4p ((<4>1D)2D)3F
-	59465.0	-	54% 3d5 4p (<3>4F)3F + 7% 3d5 4p (<5>2D)3F
60518.0	59848.0	670.0	71% 3d5 4p (<3>4F)3D + 5% 3d5 4p (<5>2F)3D
60616.0	60072.0	544.0	49% 3d5 4p (<5>2G)3G + 17% 3d5 4p (<3>2H)3G
60819.0	60299.0	520.0	33% 3d5 4p (<3>2F)1F + 26% 3d5 4p (<5>2D)1F
60902.0	60948.0	-46.0	44% 3d5 4p (<5>2G)3F + 13% 3d4 4s 4p ((<4>1D)2D)3F
61078.0	61855.0	-777.0	39% 3d5 4p (<5>2F)3D + 17% 3d4 4s 4p ((<4>3P)4P)3D
61199.0	61963.0	-764.0	39% 3d5 4p (<5>2F)3F + 36% 3d4 4s 4p ((<4>1F)2F)3F
61930.0	62564.0	-634.0	33% 3d5 4p (<5>2F)3G + 12% 3d5 4p (<3>4F)3G
62034.0	62704.0	-670.0	70% 3d5 4p (<5>2G)1F + 5% 3d5 4p (<5>2F)3G
-	63155.0	-	20% 3d5 4p (<3>4F)3G + 19% 3d4 4s 4p ((<4>3H)2H)3G
-	63913.0	-	26% 3d4 4s 4p ((<4>3F)4F)3D + 17% 3d4 4s 4p ((<4>3F)2F)3D
-	64814.0	-	82% 3d4 4s 4p ((<4>1F)2F)3G
-	64865.0	-	42% 3d4 4s 4p ((<4>1F)2F)3F + 25% 3d5 4p (<5>2F)3F
-	65256.0	-	68% 3d5 4p (<5>2F)1F + 12% 3d4 4s 4p ((<4>1G)2G)1F
-	65340.0	-	20% 3d4 4s 4p ((<4>3F)4F)3F + 18% 3d5 4p (<5>2G)3F
-	66003.0	-	85% 3d4 4s 4p ((<4>1F)2F)3D
66009.0	66169.0	-160.0	41% 3d5 4p (<5>2F)3G + 12% 3d5 4p (<3>2H)3G
-	66547.0	-	30% 3d4 4s 4p ((<4>3G)4G)3F + 23% 3d4 4s 4p ((<4>3G)2G)3F
-	66748.0	-	38% 3d4 4s 4p ((<4>3G)4G)3G + 23% 3d4 4s 4p ((<4>3G)2G)3G
-	66819.0	-	39% 3d5 4p (<5>2F)3D + 7% 3d4 4s 4p ((<4>3P)4P)3D
-	67982.0	-	80% 3d4 4s 4p ((<2>3F)4F)5F + 16% 3d4 4s 4p ((<4>3F)4F)5F
-	68601.0	-	45% 3d4 4s 4p ((<2>3P)4P)5P + 25% 3d4 4s 4p ((<4>3P)4P)5P
-	68895.0	-	26% 3d4 4s 4p ((<2>3P)4P)5D + 23% 3d4 4s 4p ((<2>3F)4F)5D
-	69042.0	-	76% 3d4 4s 4p ((<2>3F)4F)5G + 23% 3d4 4s 4p ((<4>3F)4F)5G
-	69850.0	-	36% 3d4 4s 4p ((<4>3D)4D)3D + 29% 3d5 4p (<3>2D)3D
-	70421.0	-	43% 3d4 4s 4p ((<4>3D)4D)3F + 29% 3d4 4s 4p ((<4>3D)2D)3F

	-	71337.0	-	25% 3d4 4s 4p ((<2>3F)4F)5D + 10% 3d4 4s 4p ((<2>3P)4P)5D
	-	71352.0	-	27% 3d4 4s 4p ((<4>1G)2G)1F + 18% 3d4 4s 4p ((<2>1G)2G)1F
	-	71491.0	-	11% 3d4 4s 4p ((<2>3P)2P)3D + 9% 3d4 4s 4p ((<2>3F)4F)5D
	-	71587.0	-	28% 3d4 4s 4p ((<2>3F)2F)3F + 22% 3d4 4s 4p ((<2>3F)4F)3F
	-	72609.0	-	49% 3d5 4p (<3>2D)1F + 12% 3d4 4s 4p ((<4>1D)2D)1F
	-	73145.0	-	39% 3d4 4s 4p ((<2>3F)2F)3G + 29% 3d4 4s 4p ((<2>3F)4F)3G
	-	73219.0	-	78% 3d5 4p (<3>2D)3F
	-	73927.0	-	62% 3d4 4s 4p ((<2>3F)2F)1F + 18% 3d5 4p (<3>2D)1F
	-	74576.0	-	64% 3d5 4p (<3>2D)3D + 15% 3d4 4s 4p ((<4>3D)4D)3D
	-	75784.0	-	52% 3d4 4s 4p ((<2>1G)2G)3G + 31% 3d4 4s 4p ((<4>1G)2G)3G
	-	76181.0	-	28% 3d4 4s 4p ((<2>3F)2F)3D + 17% 3d4 4s 4p ((<2>3F)4F)3D
	-	76246.0	-	49% 3d4 4s 4p ((<4>1D)2D)1F + 17% 3d4 4s 4p ((<2>1D)2D)1F
	-	77185.0	-	59% 3d4 4s 4p ((<2>1G)2G)3F + 25% 3d4 4s 4p ((<4>1G)2G)3F
	-	78342.0	-	73% 3d5 4p (<3>2G)3F + 8% 3d4 4s 4p ((<2>3F)2F)3F
	-	78566.0	-	78% 3d5 4p (<3>2G)3G + 10% 3d4 4s 4p ((<2>1G)2G)3G
	-	78821.0	-	47% 3d5 4p (<3>2G)1F + 34% 3d4 4s 4p ((<4>1F)2F)1F
	-	80589.0	-	53% 3d4 4s 4p ((<4>1F)2F)1F + 31% 3d5 4p (<3>2G)1F
	-	86047.0	-	42% 3d4 4s 4p ((<2>3F)4F)3F + 29% 3d4 4s 4p ((<2>3F)2F)3F
	-	86343.0	-	18% 3d4 4s 4p ((<2>3F)4F)3D + 16% 3d4 4s 4p ((<2>3P)4P)3D
	-	87211.0	-	45% 3d4 4s 4p ((<2>3F)4F)3G + 29% 3d4 4s 4p ((<2>3F)2F)3G
	-	87749.0	-	24% 3d5 4p (<3>2P)3D + 16% 3d4 4s 4p ((<2>3P)4P)3D
	-	90883.0	-	67% 3d5 4p (<3>2P)3D + 10% 3d5 4p (<1>2D)3D
	-	91544.0	-	46% 3d4 4s 4p ((<2>1G)2G)1F + 22% 3d4 4s 4p ((<4>1G)2G)1F
	-	92578.0	-	73% 3d4 4s 4p ((<2>1D)2D)3F + 20% 3d4 4s 4p ((<4>1D)2D)3F
	-	94583.0	-	74% 3d4 4s 4p ((<2>1D)2D)3D + 24% 3d4 4s 4p ((<4>1D)2D)3D
	-	95487.0	-	70% 3d5 4p (<1>2D)3F + 22% 3d5 4p (<5>2D)3F
	-	96858.0	-	63% 3d5 4p (<1>2D)3D + 19% 3d5 4p (<5>2D)3D
	-	98393.0	-	55% 3d5 4p (<1>2D)1F + 17% 3d4 4s 4p ((<2>1G)2G)1F
	-	108366.0	-	76% 3d4 4s 4p ((<2>1D)2D)1F + 21% 3d4 4s 4p ((<4>1D)2D)1F
4	23499.0	22782.0	717.0	84% 3d5 4p (<5>6S)7P + 16% 3d4 4s 4p ((<4>5D)6D)7P
	25360.0	24950.0	410.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	-	26173.0	-	84% 3d4 4s 4p ((<4>5D)6D)7P + 16% 3d5 4p (<5>6S)7P
	27650.0	26763.0	887.0	100% 3d4 4s 4p ((<4>5D)6D)7D
	31106.0	30694.0	412.0	53% 3d4 4s 4p ((<4>5D)6D)5F + 44% 3d4 4s 4p ((<4>5D)4D)5F
	33816.0	33150.0	666.0	51% 3d4 4s 4p ((<4>5D)6D)5D + 48% 3d4 4s 4p ((<4>5D)4D)5D
	-	35106.0	-	97% 3d4 4s 4p ((<4>5D)4D)3F
	41225.0	41202.0	23.0	80% 3d4 4s 4p ((<4>3H)4H)5H + 10% 3d5 4p (<5>4G)5H
	42080.0	41990.0	90.0	56% 3d5 4p (<5>4G)5G + 29% 3d4 4s 4p ((<4>3H)4H)5G
	42565.0	42249.0	316.0	47% 3d5 4p (<5>4G)5F + 32% 3d4 4s 4p ((<4>5D)4D)5F
	41782.0	42298.0	-516.0	99% 3d4 4s 4p ((<4>3H)4H)5I
	42909.0	43222.0	-313.0	33% 3d4 4s 4p ((<4>3P)4P)5D + 20% 3d4 4s 4p ((<2>3P)4P)5D
	44247.0	44076.0	171.0	46% 3d5 4p (<5>4G)5H + 24% 3d4 4s 4p ((<4>3F)4F)5G
	44534.0	44118.0	416.0	41% 3d5 4p (<5>4G)5H + 27% 3d4 4s 4p ((<4>3F)4F)5G
	-	44654.0	-	28% 3d4 4s 4p ((<4>5D)4D)5D + 23% 3d4 4s 4p ((<4>5D)6D)5D
	-	44764.0	-	57% 3d4 4s 4p ((<4>3F)4F)5F + 12% 3d4 4s 4p ((<2>3F)4F)5F
	-	44908.0	-	87% 3d5 4p (<5>4G)3H + 8% 3d4 4s 4p ((<4>3H)2H)3H
	-	44962.0	-	50% 3d4 4s 4p ((<4>3H)4H)5G + 21% 3d5 4p (<5>4G)5G
	45286.0	45172.0	114.0	89% 3d5 4p (<5>4G)3F
	45359.0	45807.0	-448.0	37% 3d4 4s 4p ((<4>3H)2H)3G + 25% 3d4 4s 4p ((<4>3H)4H)3G
	45615.0	45954.0	-339.0	39% 3d4 4s 4p ((<4>3F)4F)5D + 23% 3d4 4s 4p ((<4>3P)4P)5D
	46058.0	46414.0	-356.0	74% 3d5 4p (<5>4G)3G + 11% 3d4 4s 4p ((<4>3H)4H)3G
	46422.0	46549.0	-127.0	38% 3d4 4s 4p ((<4>3H)2H)3H + 30% 3d4 4s 4p ((<4>3H)4H)3H
	46721.0	46567.0	154.0	64% 3d4 4s 4p ((<4>3G)4G)5H + 9% 3d4 4s 4p ((<4>3H)2H)3H
	46905.0	46687.0	218.0	51% 3d4 4s 4p ((<4>3G)4G)5F + 24% 3d5 4p (<5>4D)5F
	47055.0	47406.0	-351.0	69% 3d4 4s 4p ((<4>3H)2H)1G + 18% 3d4 4s 4p ((<4>3F)2F)1G
	47190.0	47779.0	-589.0	32% 3d5 4p (<5>4G)5F + 22% 3d4 4s 4p ((<4>5D)6D)5F
	47689.0	47947.0	-258.0	52% 3d4 4s 4p ((<4>3G)4G)5G + 22% 3d5 4p (<3>4P)5D
	47866.0	47993.0	-127.0	47% 3d5 4p (<3>4P)5D + 23% 3d4 4s 4p ((<4>3G)4G)5G
	48014.0	48652.0	-638.0	20% 3d4 4s 4p ((<4>3F)2F)3F + 16% 3d4 4s 4p ((<4>3F)4F)3F
	48288.0	48859.0	-571.0	22% 3d4 4s 4p ((<4>3F)2F)3G + 14% 3d4 4s 4p ((<4>3F)4F)3G
	49454.0	49345.0	109.0	63% 3d5 4p (<5>4D)5F + 21% 3d4 4s 4p ((<4>3G)4G)5F
	49573.0	49756.0	-183.0	44% 3d4 4s 4p ((<4>3G)2G)3H + 33% 3d4 4s 4p ((<4>3G)4G)3H
	49621.0	49848.0	-227.0	28% 3d4 4s 4p ((<4>3G)2G)3F + 26% 3d5 4p (<5>4D)3F
	49864.0	50519.0	-655.0	67% 3d5 4p (<5>4D)5D + 10% 3d4 4s 4p ((<4>5D)4D)5D
	50211.0	50818.0	-607.0	58% 3d5 4p (<5>4D)3F + 20% 3d4 4s 4p ((<4>3G)4G)3F
	50558.0	51242.0	-684.0	50% 3d4 4s 4p ((<4>3F)2F)1G + 17% 3d4 4s 4p ((<4>3H)2H)1G
	51060.0	51399.0	-339.0	45% 3d4 4s 4p ((<4>3G)2G)3G + 34% 3d4 4s 4p ((<4>3G)4G)3G
	-	52186.0	-	41% 3d5 4p (<5>2I)3H + 27% 3d4 4s 4p ((<4>1G)2G)3H
	52064.0	52369.0	-305.0	95% 3d4 4s 4p ((<4>3D)4D)5D
	52963.0	52999.0	-36.0	43% 3d4 4s 4p ((<4>1G)2G)3F + 20% 3d4 4s 4p ((<2>1G)2G)3F
	52720.0	53022.0	-302.0	69% 3d4 4s 4p ((<4>3D)4D)5F + 13% 3d4 4s 4p ((<4>1G)2G)3F
	53118.0	53435.0	-317.0	36% 3d5 4p (<5>2I)3H + 25% 3d4 4s 4p ((<4>1G)2G)3H
	-	53543.0	-	82% 3d4 4s 4p ((<4>3G)2G)1G + 5% 3d4 4s 4p ((<4>3H)2H)1G
	54737.0	53947.0	790.0	75% 3d4 4s 4p ((<4>1I)2I)3H + 6% 3d4 4s 4p ((<2>1G)2G)3H
	54811.0	54083.0	728.0	49% 3d4 4s 4p ((<4>1G)2G)3G + 30% 3d4 4s 4p ((<2>1G)2G)3G
	55207.0	55319.0	-112.0	30% 3d5 4p (<5>2D)3F + 18% 3d5 4p (<3>2F)3F
	56280.0	57188.0	-908.0	47% 3d5 4p (<3>2F)1G + 13% 3d4 4s 4p ((<4>3D)2D)3F
	57034.0	57262.0	-228.0	23% 3d5 4p (<3>2F)3F + 17% 3d4 4s 4p ((<4>3D)2D)3F
	57168.0	57313.0	-145.0	61% 3d5 4p (<3>2F)3G + 19% 3d5 4p (<3>2F)3F
	57227.0	57602.0	-375.0	46% 3d5 4p (<3>4F)3G + 8% 3d5 4p (<3>4F)5G
	57335.0	57799.0	-464.0	58% 3d5 4p (<3>4F)5G + 8% 3d5 4p (<5>2D)3F
	57587.0	57999.0	-412.0	30% 3d5 4p (<3>4F)5G + 17% 3d5 4p (<5>2D)3F
	-	58234.0	-	89% 3d5 4p (<3>4F)5F
	58728.0	58507.0	221.0	62% 3d5 4p (<3>2H)3H + 11% 3d4 4s 4p ((<4>3H)4H)3H
	-	58797.0	-	43% 3d5 4p (<3>2H)3G + 9% 3d4 4s 4p ((<4>3H)2H)3G

	59488.0	59130.0	358.0	42% 3d5 4p (<3>4F)5D	+ 18% 3d4 4s 4p ((<4>1D)2D)3F
	-	59365.0	-	38% 3d4 4s 4p ((<4>1D)2D)3F	+ 29% 3d5 4p (<3>4F)5D
	-	59444.0	-	51% 3d5 4p (<3>4F)3F	+ 16% 3d5 4p (<3>4F)5D
	60504.0	59957.0	547.0	33% 3d5 4p (<3>2H)1G	+ 20% 3d5 4p (<5>2G)1G
	-	60100.0	-	34% 3d5 4p (<5>2G)3G	+ 12% 3d5 4p (<3>2H)1G
	60871.0	60498.0	373.0	70% 3d5 4p (<5>2G)3H	+ 13% 3d4 4s 4p ((<4>3H)4H)3H
	60961.0	60930.0	31.0	44% 3d5 4p (<5>2G)3F	+ 13% 3d4 4s 4p ((<4>1D)2D)3F
	61977.0	61902.0	75.0	49% 3d5 4p (<5>2G)1G	+ 30% 3d5 4p (<3>2H)1G
	61123.0	61934.0	-811.0	39% 3d5 4p (<5>2F)3F	+ 36% 3d4 4s 4p ((<4>1F)2F)3F
	-	62528.0	-	33% 3d5 4p (<5>2F)3G	+ 12% 3d5 4p (<3>4F)3G
	-	62728.0	-	21% 3d5 4p (<3>2H)3H	+ 20% 3d4 4s 4p ((<4>3H)4H)3H
	62762.0	63156.0	-394.0	18% 3d4 4s 4p ((<4>3H)2H)3G	+ 18% 3d4 4s 4p ((<4>3H)4H)3G
	63842.0	63993.0	-151.0	85% 3d5 4p (<5>2F)1G	+ 4% 3d4 4s 4p ((<4>1G)2G)1G
	-	64788.0	-	45% 3d4 4s 4p ((<4>3G)4G)3H	+ 29% 3d4 4s 4p ((<4>3G)2G)3H
	-	64853.0	-	41% 3d4 4s 4p ((<4>1F)2F)3F	+ 25% 3d5 4p (<5>2F)3F
	-	64896.0	-	76% 3d4 4s 4p ((<4>1F)2F)3G	+ 4% 3d4 4s 4p ((<4>1F)2F)3F
	-	65385.0	-	24% 3d4 4s 4p ((<4>3F)4F)3F	+ 19% 3d5 4p (<5>2G)3F
	66094.0	66248.0	-154.0	41% 3d5 4p (<5>2F)3G	+ 12% 3d5 4p (<3>2H)3G
	-	66672.0	-	33% 3d4 4s 4p ((<4>3G)4G)3F	+ 25% 3d4 4s 4p ((<4>3G)2G)3F
	-	66878.0	-	39% 3d4 4s 4p ((<4>3G)4G)3G	+ 24% 3d4 4s 4p ((<4>3G)2G)3G
	-	67989.0	-	80% 3d4 4s 4p ((<2>3F)4F)5F	+ 16% 3d4 4s 4p ((<4>3F)4F)5F
	-	68699.0	-	39% 3d4 4s 4p ((<2>3P)4P)5D	+ 29% 3d4 4s 4p ((<2>3F)4F)5D
	-	69072.0	-	76% 3d4 4s 4p ((<2>3F)4F)5G	+ 23% 3d4 4s 4p ((<4>3F)4F)5G
	-	70426.0	-	43% 3d4 4s 4p ((<4>3D)4D)3F	+ 30% 3d4 4s 4p ((<4>3D)2D)3F
	-	71259.0	-	45% 3d4 4s 4p ((<2>3F)4F)5D	+ 21% 3d4 4s 4p ((<2>3P)4P)5D
	-	71559.0	-	25% 3d4 4s 4p ((<2>3F)2F)3F	+ 20% 3d4 4s 4p ((<2>3F)4F)3F
	-	71640.0	-	37% 3d4 4s 4p ((<4>1G)2G)1G	+ 20% 3d4 4s 4p ((<2>1G)2G)1G
	-	73133.0	-	41% 3d4 4s 4p ((<2>3F)2F)3G	+ 32% 3d4 4s 4p ((<2>3F)4F)3G
	-	73283.0	-	83% 3d5 4p (<3>2D)3F	
	-	75215.0	-	71% 3d4 4s 4p ((<2>3F)2F)1G	+ 19% 3d4 4s 4p ((<4>3F)2F)1G
	-	75802.0	-	50% 3d4 4s 4p ((<2>1G)2G)3G	+ 30% 3d4 4s 4p ((<4>1G)2G)3G
	-	76146.0	-	61% 3d4 4s 4p ((<2>1G)2G)3H	+ 31% 3d4 4s 4p ((<4>1G)2G)3H
	-	77108.0	-	60% 3d4 4s 4p ((<2>1G)2G)3F	+ 25% 3d4 4s 4p ((<4>1G)2G)3F
	-	77655.0	-	98% 3d5 4p (<3>2G)3H	
	-	78275.0	-	74% 3d5 4p (<3>2G)3F	+ 8% 3d4 4s 4p ((<2>3F)2F)3F
	-	78596.0	-	78% 3d5 4p (<3>2G)3G	+ 10% 3d4 4s 4p ((<2>1G)2G)3G
	-	78830.0	-	85% 3d5 4p (<3>2G)1G	+ 6% 3d4 4s 4p ((<2>1G)2G)1G
	-	80824.0	-	92% 3d4 4s 4p ((<4>1F)2F)1G	
	-	86032.0	-	43% 3d4 4s 4p ((<2>3F)4F)3F	+ 30% 3d4 4s 4p ((<2>3F)2F)3F
	-	87208.0	-	45% 3d4 4s 4p ((<2>3F)4F)3G	+ 29% 3d4 4s 4p ((<2>3F)2F)3G
	-	92504.0	-	58% 3d4 4s 4p ((<2>1G)2G)1G	+ 34% 3d4 4s 4p ((<4>1G)2G)1G
	-	92666.0	-	72% 3d4 4s 4p ((<2>1D)2D)3F	+ 20% 3d4 4s 4p ((<4>1D)2D)3F
	-	95536.0	-	70% 3d5 4p (<1>2D)3F	+ 22% 3d5 4p (<5>2D)3F
5	25549.0	25123.0	426.0	100% 3d4 4s 4p ((<4>5D)6D)7F	
	27825.0	26943.0	882.0	100% 3d4 4s 4p ((<4>5D)6D)7D	
	31280.0	30874.0	406.0	54% 3d4 4s 4p ((<4>5D)6D)5F	+ 44% 3d4 4s 4p ((<4>5D)4D)5F
	41393.0	41275.0	118.0	80% 3d4 4s 4p ((<4>3H)4H)5H	+ 10% 3d5 4p (<5>4G)5H
	42589.0	42010.0	579.0	56% 3d5 4p (<5>4G)5G	+ 29% 3d4 4s 4p ((<4>3H)4H)5G
	-	42346.0	-	49% 3d5 4p (<5>4G)5F	+ 31% 3d4 4s 4p ((<4>5D)4D)5F
	42154.0	42386.0	-232.0	99% 3d4 4s 4p ((<4>3H)4H)5I	
	-	44117.0	-	76% 3d5 4p (<5>4G)5H	+ 10% 3d4 4s 4p ((<4>3H)4H)5H
	-	44189.0	-	43% 3d4 4s 4p ((<4>3F)4F)5G	+ 14% 3d4 4s 4p ((<2>3F)4F)5G
	44308.0	44783.0	-475.0	65% 3d4 4s 4p ((<4>3F)4F)5F	+ 13% 3d4 4s 4p ((<2>3F)4F)5F
	45354.0	44910.0	444.0	88% 3d5 4p (<5>4G)3H	+ 7% 3d4 4s 4p ((<4>3H)2H)3H
	44591.0	45024.0	-433.0	49% 3d4 4s 4p ((<4>3H)4H)5G	+ 21% 3d4 4s 4p ((<4>3F)4F)5G
	45663.0	45841.0	-178.0	37% 3d4 4s 4p ((<4>3H)2H)3G	+ 23% 3d4 4s 4p ((<4>3H)4H)3G
	-	45978.0	-	53% 3d4 4s 4p ((<4>3H)2H)3I	+ 40% 3d4 4s 4p ((<4>3H)4H)3I
	-	46444.0	-	74% 3d5 4p (<5>4G)3G	+ 13% 3d4 4s 4p ((<4>3H)4H)3G
	46705.0	46634.0	71.0	36% 3d4 4s 4p ((<4>3H)2H)3H	+ 28% 3d4 4s 4p ((<4>3H)4H)3H
	-	46673.0	-	64% 3d4 4s 4p ((<4>3G)4G)5H	+ 10% 3d4 4s 4p ((<4>3H)2H)3H
	47055.0	46734.0	321.0	49% 3d4 4s 4p ((<4>3G)4G)5F	+ 22% 3d5 4p (<5>4D)5F
	47229.0	47850.0	-621.0	32% 3d5 4p (<5>4G)5F	+ 23% 3d4 4s 4p ((<4>5D)6D)5F
	47986.0	48045.0	-59.0	77% 3d4 4s 4p ((<4>3G)4G)5G	+ 9% 3d5 4p (<5>4G)5G
	-	48867.0	-	33% 3d4 4s 4p ((<4>3F)2F)3G	+ 21% 3d4 4s 4p ((<4>3F)4F)3G
	-	49095.0	-	86% 3d4 4s 4p ((<4>3H)2H)1H	+ 5% 3d5 4p (<5>2I)1H
	-	49379.0	-	65% 3d5 4p (<5>4D)5F	+ 22% 3d4 4s 4p ((<4>3G)4G)5F
	49618.0	49868.0	-250.0	46% 3d4 4s 4p ((<4>3G)2G)3H	+ 35% 3d4 4s 4p ((<4>3G)4G)3H
	50253.0	50832.0	-579.0	68% 3d4 4s 4p ((<4>1I)2I)3I	+ 30% 3d5 4p (<5>2I)3I
	-	51398.0	-	45% 3d4 4s 4p ((<4>3G)2G)3G	+ 34% 3d4 4s 4p ((<4>3G)4G)3G
	51401.0	51800.0	-399.0	69% 3d4 4s 4p ((<4>3G)2G)1H	+ 16% 3d5 4p (<5>2I)1H
	52592.0	52151.0	441.0	40% 3d5 4p (<5>2I)3H	+ 30% 3d4 4s 4p ((<4>1G)2G)3H
	52885.0	53040.0	-155.0	90% 3d4 4s 4p ((<4>3D)4D)5F	+ 5% 3d5 4p (<5>4D)5F
	53172.0	53319.0	-147.0	53% 3d5 4p (<5>2I)3I	+ 25% 3d4 4s 4p ((<4>1I)2I)3I
	-	53462.0	-	34% 3d5 4p (<5>2I)3H	+ 21% 3d4 4s 4p ((<4>1G)2G)3H
	-	53880.0	-	37% 3d5 4p (<5>2I)1H	+ 35% 3d4 4s 4p ((<4>1I)2I)3H
	-	53948.0	-	40% 3d4 4s 4p ((<4>1I)2I)3H	+ 29% 3d5 4p (<5>2I)1H
	-	54117.0	-	52% 3d4 4s 4p ((<4>1G)2G)3G	+ 31% 3d4 4s 4p ((<2>1G)2G)3G
	57088.0	57402.0	-314.0	85% 3d5 4p (<3>2F)3G	
	57702.0	57645.0	57.0	47% 3d5 4p (<3>4F)3G	+ 14% 3d5 4p (<3>4F)5G
	-	57887.0	-	83% 3d5 4p (<3>4F)5G	+ 7% 3d5 4p (<3>4F)3G
	58755.0	58261.0	494.0	87% 3d5 4p (<3>4F)5F	
	-	58549.0	-	63% 3d5 4p (<3>2H)3H	+ 12% 3d4 4s 4p ((<4>3H)4H)3H
	59806.0	58880.0	926.0	49% 3d5 4p (<3>2H)3G	+ 9% 3d4 4s 4p ((<4>3H)2H)3G
	-	59450.0	-	91% 3d5 4p (<3>2H)3I	
	60006.0	59989.0	17.0	51% 3d5 4p (<5>2G)3G	+ 15% 3d5 4p (<3>2H)3G

	60428.0	60454.0	-26.0	33% 3d4 4s 4p ((<4>3H)4H)3I + 22% 3d5 4p (<3>2H)1H
	61008.0	60572.0	436.0	35% 3d5 4p (<3>2H)1H + 23% 3d4 4s 4p ((<4>3H)4H)3I
	60468.0	60615.0	-147.0	67% 3d5 4p (<5>2G)3H + 12% 3d4 4s 4p ((<4>3H)4H)3H
	62038.0	62112.0	-74.0	64% 3d5 4p (<5>2G)1H + 22% 3d5 4p (<3>2H)1H
	-	62512.0	-	37% 3d5 4p (<5>2F)3G + 13% 3d5 4p (<3>4F)3G
	62830.0	62805.0	25.0	24% 3d4 4s 4p ((<4>3H)4H)3H + 22% 3d5 4p (<3>2H)3H
	63927.0	63194.0	733.0	17% 3d4 4s 4p ((<4>3H)2H)3G + 17% 3d4 4s 4p ((<4>3H)4H)3G
	-	64905.0	-	44% 3d4 4s 4p ((<4>3G)4G)3H + 29% 3d4 4s 4p ((<4>3G)2G)3H
	-	64936.0	-	83% 3d4 4s 4p ((<4>1F)2F)3G
	66180.0	66358.0	-178.0	42% 3d5 4p (<5>2F)3G + 12% 3d5 4p (<3>2H)3G
	-	67005.0	-	40% 3d4 4s 4p ((<4>3G)4G)3G + 25% 3d4 4s 4p ((<4>3G)2G)3G
	-	67993.0	-	82% 3d4 4s 4p ((<2>3F)4F)5F + 16% 3d4 4s 4p ((<4>3F)4F)5F
	-	68867.0	-	49% 3d4 4s 4p ((<4>1G)2G)1H + 21% 3d4 4s 4p ((<2>1G)2G)1H
	-	69098.0	-	77% 3d4 4s 4p ((<2>3F)4F)5G + 22% 3d4 4s 4p ((<4>3F)4F)5G
	-	70888.0	-	60% 3d4 4s 4p ((<4>1I)2I)1H + 12% 3d4 4s 4p ((<4>1G)2G)1H
	-	73143.0	-	42% 3d4 4s 4p ((<2>3F)2F)3G + 33% 3d4 4s 4p ((<2>3F)4F)3G
	-	75845.0	-	49% 3d4 4s 4p ((<2>1G)2G)3G + 29% 3d4 4s 4p ((<4>1G)2G)3G
	-	76207.0	-	62% 3d4 4s 4p ((<2>1G)2G)3H + 31% 3d4 4s 4p ((<4>1G)2G)3H
	-	77685.0	-	98% 3d5 4p (<3>2G)3H
	-	78628.0	-	80% 3d5 4p (<3>2G)3G + 10% 3d4 4s 4p ((<2>1G)2G)3G
	-	79256.0	-	91% 3d5 4p (<3>2G)1H + 5% 3d4 4s 4p ((<4>1I)2I)1H
	-	87165.0	-	45% 3d4 4s 4p ((<2>3F)4F)3G + 30% 3d4 4s 4p ((<2>3F)2F)3G
	-	91940.0	-	65% 3d4 4s 4p ((<2>1G)2G)1H + 32% 3d4 4s 4p ((<4>1G)2G)1H
6	25771.0	25327.0	444.0	100% 3d4 4s 4p ((<4>5D)6D)7F
	42252.0	41368.0	884.0	80% 3d4 4s 4p ((<4>3H)4H)5H + 11% 3d5 4p (<5>4G)5H
	-	42028.0	-	57% 3d5 4p (<5>4G)5G + 29% 3d4 4s 4p ((<4>3H)4H)5G
	42606.0	42489.0	117.0	99% 3d4 4s 4p ((<4>3H)4H)5I
	44393.0	44156.0	237.0	84% 3d5 4p (<5>4G)5H + 12% 3d4 4s 4p ((<4>3H)4H)5H
	44746.0	44289.0	457.0	45% 3d4 4s 4p ((<4>3F)4F)5G + 19% 3d4 4s 4p ((<4>3H)4H)5G
	45349.0	44906.0	443.0	88% 3d5 4p (<5>4G)3H + 6% 3d4 4s 4p ((<4>3H)2H)3H
	-	45105.0	-	46% 3d4 4s 4p ((<4>3H)4H)5G + 25% 3d4 4s 4p ((<4>3F)4F)5G
	45707.0	46051.0	-344.0	53% 3d4 4s 4p ((<4>3H)2H)3I + 40% 3d4 4s 4p ((<4>3H)4H)3I
	47222.0	46743.0	479.0	39% 3d4 4s 4p ((<4>3H)2H)3H + 30% 3d4 4s 4p ((<4>3H)4H)3H
	47630.0	46799.0	831.0	68% 3d4 4s 4p ((<4>3G)4G)5H + 11% 3d4 4s 4p ((<4>3H)2H)3H
	47942.0	48113.0	-171.0	68% 3d4 4s 4p ((<4>3G)4G)5G + 15% 3d4 4s 4p ((<4>3H)2H)1I
	48445.0	48166.0	279.0	82% 3d4 4s 4p ((<4>3H)2H)1I + 13% 3d4 4s 4p ((<4>3G)4G)5G
	49635.0	50004.0	-369.0	45% 3d4 4s 4p ((<4>3G)2G)3H + 35% 3d4 4s 4p ((<4>3G)4G)3H
	-	50838.0	-	69% 3d4 4s 4p ((<4>1I)2I)3I + 29% 3d5 4p (<5>2I)3I
	-	52029.0	-	96% 3d4 4s 4p ((<4>1I)2I)3K
	52661.0	52149.0	512.0	40% 3d5 4p (<5>2I)3H + 30% 3d4 4s 4p ((<4>1G)2G)3H
	52915.0	52662.0	253.0	95% 3d5 4p (<5>2I)3K
	-	53349.0	-	52% 3d5 4p (<5>2I)3I + 23% 3d4 4s 4p ((<4>1I)2I)3I
	-	53489.0	-	35% 3d5 4p (<5>2I)3H + 19% 3d4 4s 4p ((<4>1G)2G)3H
	-	53898.0	-	70% 3d4 4s 4p ((<4>1I)2I)3H + 9% 3d4 4s 4p ((<2>1G)2G)3H
	-	54356.0	-	87% 3d5 4p (<5>2I)1I + 8% 3d4 4s 4p ((<4>1I)2I)1I
	-	57871.0	-	97% 3d5 4p (<3>4F)5G
	58775.0	58595.0	180.0	64% 3d5 4p (<3>2H)3H + 12% 3d4 4s 4p ((<4>3H)4H)3H
	-	59515.0	-	93% 3d5 4p (<3>2H)3I
	60441.0	60202.0	239.0	84% 3d5 4p (<3>2H)1I + 6% 3d5 4p (<5>2G)3H
	60528.0	60632.0	-104.0	55% 3d4 4s 4p ((<4>3H)4H)3I + 35% 3d4 4s 4p ((<4>3H)2H)3I
	61192.0	60762.0	430.0	66% 3d5 4p (<5>2G)3H + 10% 3d4 4s 4p ((<4>3H)4H)3H
	62658.0	62881.0	-223.0	27% 3d4 4s 4p ((<4>3H)4H)3H + 23% 3d5 4p (<3>2H)3H
	64836.0	65022.0	-186.0	49% 3d4 4s 4p ((<4>3G)4G)3H + 32% 3d4 4s 4p ((<4>3G)2G)3H
	-	68451.0	-	90% 3d4 4s 4p ((<4>1I)2I)1I + 6% 3d5 4p (<5>2I)1I
	-	69115.0	-	77% 3d4 4s 4p ((<2>3F)4F)5G + 22% 3d4 4s 4p ((<4>3F)4F)5G
	-	76266.0	-	66% 3d4 4s 4p ((<2>1G)2G)3H + 33% 3d4 4s 4p ((<4>1G)2G)3H
	-	77726.0	-	98% 3d5 4p (<3>2G)3H
7	-	41483.0	-	81% 3d4 4s 4p ((<4>3H)4H)5H + 11% 3d5 4p (<5>4G)5H
	42387.0	42603.0	-216.0	99% 3d4 4s 4p ((<4>3H)4H)5I
	-	44200.0	-	86% 3d5 4p (<5>4G)5H + 13% 3d4 4s 4p ((<4>3H)4H)5H
	-	46145.0	-	51% 3d4 4s 4p ((<4>3H)2H)3I + 40% 3d4 4s 4p ((<4>3H)4H)3I
	-	46933.0	-	86% 3d4 4s 4p ((<4>3G)4G)5H + 5% 3d4 4s 4p ((<4>3H)4H)5H
	-	50847.0	-	70% 3d4 4s 4p ((<4>1I)2I)3I + 29% 3d5 4p (<5>2I)3I
	-	52098.0	-	96% 3d4 4s 4p ((<4>1I)2I)3K
	52678.0	52714.0	-36.0	95% 3d5 4p (<5>2I)3K
	-	53217.0	-	97% 3d5 4p (<5>2I)1K
	54405.0	53410.0	995.0	61% 3d5 4p (<5>2I)3I + 27% 3d4 4s 4p ((<4>1I)2I)3I
	59957.0	59595.0	362.0	95% 3d5 4p (<3>2H)3I
	60657.0	60778.0	-121.0	56% 3d4 4s 4p ((<4>3H)4H)3I + 36% 3d4 4s 4p ((<4>3H)2H)3I
	-	67876.0	-	98% 3d4 4s 4p ((<4>1I)2I)1K
8	-	42728.0	-	100% 3d4 4s 4p ((<4>3H)4H)5I
	-	52175.0	-	96% 3d4 4s 4p ((<4>1I)2I)3K + 4% 3d5 4p (<5>2I)3K
	-	52783.0	-	96% 3d5 4p (<5>2I)3K + 4% 3d4 4s 4p ((<4>1I)2I)

Table-III.

Observed and least squares fitted energy levels of even parity configurations of Cr II in cm^{-1}:

J	E(obs)	E(LSF)	diff.	LS-composition.
1/2	11962.0	12386.0	-424.0	100% 3d4 4s (<4>5D)6D
	19528.0	19572.0	-44.0	89% 3d4 4s (<4>5D)4D + 11% 3d5 <5>4D
	21824.0	22030.0	-206.0	96% 3d5 <3>4P
	25035.0	25110.0	-75.0	87% 3d5 <5>4D + 11% 3d4 4s (<4>5D)4D
	29952.0	30611.0	-659.0	58% 3d4 4s (<4>3P)4P + 38% 3d4 4s (<2>3P)4P
	34659.0	35134.0	-475.0	60% 3d4 4s (<4>3P)2P + 39% 3d4 4s (<2>3P)2P
	38396.0	39033.0	-637.0	99% 3d4 4s (<4>3D)4D
	40415.0	40208.0	207.0	56% 3d5 <5>2S + 34% 3d4 4s (<4>1S)2S
	-	45947.0	-	44% 3d4 4s (<4>1S)2S + 42% 3d5 <5>2S
	55626.0	55901.0	-275.0	61% 3d4 4s (<2>3P)4P + 39% 3d4 4s (<4>3P)4P
	59527.0	58796.0	731.0	41% 3d4 4s (<2>3P)2P + 29% 3d4 4s (<4>3P)2P
	-	64345.0	-	68% 3d5 <3>2P + 20% 3d4 4s (<2>3P)2P
	87454.0	87121.0	333.0	73% 3d4 4d (<4>5D)6D + 27% 3d4 4d (<4>5D)6F
	87595.0	87230.0	365.0	73% 3d4 4d (<4>5D)6F + 27% 3d4 4d (<4>5D)6D
	89255.0	89886.0	-631.0	81% 3d4 4d (<4>5D)4P + 14% 3d4 4d (<4>5D)4D
	89652.0	90109.0	-457.0	81% 3d4 4d (<4>5D)4D + 14% 3d4 4d (<4>5D)4P
	-	96495.0	-	78% 3d4 4s (<0>1S)2S + 22% 3d4 4s (<4>1S)2S
	-	105967.0	-	35% 3d4 4d (<4>3P)4D + 27% 3d4 4d (<4>3F)4D
	-	106434.0	-	38% 3d4 4d (<4>3F)2P + 24% 3d4 4d (<4>3P)2P
	-	106926.0	-	32% 3d4 4d (<4>3P)4P + 29% 3d4 4d (<4>3F)4P
	-	107311.0	-	32% 3d4 4d (<4>3G)4D + 28% 3d4 4d (<4>3F)4D
	-	108652.0	-	31% 3d4 4d (<4>3P)2P + 29% 3d4 4d (<4>3F)2P
	-	110675.0	-	41% 3d4 4d (<4>3G)4D + 37% 3d4 4d (<4>3D)4D
	-	111717.0	-	40% 3d4 4d (<4>3D)4P + 26% 3d4 4d (<4>3F)4P
	-	114582.0	-	91% 3d4 4d (<4>3D)2P
	-	116966.0	-	58% 3d4 4d (<4>3D)2S + 31% 3d4 4d (<4>1D)2S
	-	117210.0	-	56% 3d4 4d (<4>3D)4P + 20% 3d4 4d (<4>3F)4P
	-	118204.0	-	59% 3d4 4d (<4>3D)4D + 19% 3d4 4d (<4>3G)4D
	-	120580.0	-	78% 3d4 4d (<4>1D)2P + 18% 3d4 4d (<2>1D)2P
	-	125926.0	-	88% 3d4 4d (<4>1F)2P + 5% 3d4 4d (<2>3P)2P
	-	129195.0	-	42% 3d4 4d (<4>1D)2S + 37% 3d4 4d (<4>3D)2S
	-	130233.0	-	40% 3d4 4d (<2>3P)4P + 27% 3d4 4d (<2>3F)4P
	-	130420.0	-	68% 3d4 4d (<2>3F)4D + 17% 3d4 4d (<4>3F)4D
	-	130938.0	-	48% 3d4 4d (<2>3P)4D + 31% 3d4 4d (<4>3P)4D
	-	131387.0	-	40% 3d4 4d (<2>3F)2P + 28% 3d4 4d (<2>3P)2P
	-	132881.0	-	55% 3d4 4d (<2>3F)4P + 29% 3d4 4d (<2>3P)4P
	-	137626.0	-	27% 3d4 4d (<2>3F)2P + 23% 3d4 4d (<2>3P)2P
	-	152218.0	-	76% 3d4 4d (<2>1D)2S + 23% 3d4 4d (<4>1D)2S
	-	156813.0	-	71% 3d4 4d (<2>1D)2P + 19% 3d4 4d (<4>1D)2P
3/2	12033.0	12462.0	-429.0	100% 3d4 4s (<4>5D)6D
	19631.0	19670.0	-39.0	88% 3d4 4s (<4>5D)4D + 11% 3d5 <5>4D
	21824.0	22030.0	-206.0	96% 3d5 <3>4P
	25043.0	25129.0	-86.0	86% 3d5 <5>4D + 11% 3d4 4s (<4>5D)4D
	30307.0	30951.0	-644.0	59% 3d4 4s (<4>3F)4F + 19% 3d5 <3>4F
	31083.0	30967.0	116.0	57% 3d4 4s (<4>3P)4P + 37% 3d4 4s (<2>3P)4P
	31531.0	31619.0	-88.0	69% 3d5 <5>2D + 22% 3d5 <1>2D
	32845.0	33152.0	-307.0	78% 3d5 <3>4F + 14% 3d4 4s (<4>3F)4F
	35356.0	35852.0	-496.0	61% 3d4 4s (<4>3P)2P + 38% 3d4 4s (<2>3P)2P
	38362.0	39005.0	-643.0	99% 3d4 4s (<4>3D)4D
	42987.0	43446.0	-459.0	78% 3d4 4s (<4>3D)2D + 16% 3d5 <3>2D
	45669.0	45085.0	584.0	66% 3d4 4s (<4>1D)2D + 17% 3d4 4s (<2>1D)2D
	47373.0	47591.0	-218.0	71% 3d5 <3>2D + 11% 3d4 4s (<4>1D)2D
	54869.0	54986.0	-117.0	78% 3d4 4s (<2>3F)4F + 22% 3d4 4s (<4>3F)4F
	55399.0	55662.0	-263.0	61% 3d4 4s (<2>3P)4P + 39% 3d4 4s (<4>3P)4P
	59130.0	58460.0	670.0	43% 3d4 4s (<2>3P)2P + 30% 3d4 4s (<4>3P)2P
	-	64205.0	-	71% 3d5 <3>2P + 18% 3d4 4s (<2>3P)2P
	-	67345.0	-	71% 3d5 <1>2D + 24% 3d5 <5>2D
	-	78291.0	-	77% 3d4 4s (<2>1D)2D + 22% 3d4 4s (<4>1D)2D
	86165.0	85890.0	275.0	97% 3d4 4d (<4>5D)4S
	86594.0	86190.0	404.0	100% 3d4 4d (<4>5D)6G
	86668.0	86362.0	306.0	95% 3d4 4d (<4>5D)6P
	87471.0	87131.0	340.0	59% 3d4 4d (<4>5D)6D + 39% 3d4 4d (<4>5D)6F
	87666.0	87316.0	350.0	60% 3d4 4d (<4>5D)6F + 39% 3d4 4d (<4>5D)6D
	89278.0	89894.0	-616.0	70% 3d4 4d (<4>5D)4P + 25% 3d4 4d (<4>5D)4D
	89724.0	90212.0	-488.0	69% 3d4 4d (<4>5D)4D + 25% 3d4 4d (<4>5D)4P
	90513.0	91157.0	-644.0	93% 3d4 4d (<4>5D)4F
	-	105159.0	-	62% 3d4 4d (<4>3H)4F + 21% 3d4 4d (<4>3G)4F
	-	105818.0	-	31% 3d4 4d (<4>3P)4F + 18% 3d4 4d (<2>3P)4F
	-	106085.0	-	21% 3d4 4d (<4>3P)4F + 14% 3d4 4d (<4>3F)4D
	-	106263.0	-	23% 3d4 4d (<4>3P)2P + 22% 3d4 4d (<4>3F)2P
	-	106812.0	-	30% 3d4 4d (<4>3P)4P + 24% 3d4 4d (<4>3F)4P
	-	107022.0	-	71% 3d4 4d (<4>3F)4F + 12% 3d4 4d (<2>3F)4F
	-	107270.0	-	41% 3d4 4d (<4>3P)2D + 16% 3d4 4d (<2>3P)2D
	-	107405.0	-	27% 3d4 4d (<4>3G)4D + 21% 3d4 4d (<4>3F)4D
	-	108379.0	-	29% 3d4 4d (<4>3F)2P + 25% 3d4 4d (<4>3P)2P

	-	108994.0	-	78% 3d4 4d (<4>3G)2D + 13% 3d4 4d (<4>3D)2D
	-	110314.0	-	45% 3d4 4d (<4>3G)4F + 20% 3d4 4d (<4>3D)4F
	-	110681.0	-	32% 3d4 4d (<4>3F)2D + 10% 3d4 4d (<4>1G)2D
	-	110775.0	-	30% 3d4 4d (<4>3G)4D + 28% 3d4 4d (<4>3D)4D
	-	111616.0	-	40% 3d4 4d (<4>3D)4P + 28% 3d4 4d (<4>3F)4P
	-	113129.0	-	99% 3d4 4d (<4>3D)4S
	-	114109.0	-	76% 3d4 4d (<4>3D)4F + 15% 3d4 4d (<4>3G)4F
	-	114647.0	-	89% 3d4 4d (<4>3D)2P
	-	116268.0	-	30% 3d4 4d (<4>3D)2D + 29% 3d4 4d (<4>1G)2D
	-	116649.0	-	34% 3d4 4d (<4>3D)2D + 27% 3d4 4d (<4>1S)2D
	-	117239.0	-	57% 3d4 4d (<4>3D)4P + 21% 3d4 4d (<4>3F)4P
	-	118213.0	-	58% 3d4 4d (<4>3D)4D + 19% 3d4 4d (<4>3G)4D
	-	120617.0	-	76% 3d4 4d (<4>1D)2P + 17% 3d4 4d (<2>1D)2P
	-	120912.0	-	37% 3d4 4d (<4>1S)2D + 20% 3d4 4d (<4>1F)2D
	-	124750.0	-	42% 3d4 4d (<4>1D)2D + 14% 3d4 4d (<4>3F)2D
	-	125791.0	-	87% 3d4 4d (<4>1F)2P + 5% 3d4 4d (<2>3F)2P
	-	128055.0	-	57% 3d4 4d (<4>1F)2D + 8% 3d4 4d (<4>3D)2D
	-	130246.0	-	35% 3d4 4d (<2>3P)4P + 25% 3d4 4d (<2>3F)4P
	-	130433.0	-	64% 3d4 4d (<2>3F)4D + 16% 3d4 4d (<4>3F)4D
	-	130890.0	-	41% 3d4 4d (<2>3P)4D + 27% 3d4 4d (<4>3P)4D
	-	131184.0	-	43% 3d4 4d (<2>3P)4F + 24% 3d4 4d (<4>3P)4F
	-	131478.0	-	40% 3d4 4d (<2>3F)2P + 28% 3d4 4d (<2>3P)2P
	-	132928.0	-	53% 3d4 4d (<2>3F)4P + 30% 3d4 4d (<2>3P)4P
	-	133260.0	-	40% 3d4 4d (<2>3P)2D + 19% 3d4 4d (<4>3P)2D
	-	135327.0	-	63% 3d4 4d (<2>3F)4F + 14% 3d4 4d (<2>3P)4F
	-	135584.0	-	57% 3d4 4d (<2>3F)2D + 14% 3d4 4d (<2>1G)2D
	-	137866.0	-	26% 3d4 4d (<2>3F)2P + 24% 3d4 4d (<2>3P)2P
	-	145487.0	-	36% 3d4 4d (<2>1G)2D + 17% 3d4 4d (<2>3P)2D
	-	155669.0	-	73% 3d4 4d (<2>1D)2D + 17% 3d4 4d (<4>1D)2D
	-	156757.0	-	71% 3d4 4d (<2>1D)2P + 19% 3d4 4d (<4>1D)2P
	-	173952.0	-	81% 3d4 4d (<0>1S)2D + 18% 3d4 4d (<4>1S)2D
5/2	0.0	-529.0	529.0	100% 3d5 <5>6S
	12148.0	12585.0	-437.0	100% 3d4 4s (<4>5D)6D
	19798.0	19832.0	-34.0	87% 3d4 4s (<4>5D)4D + 12% 3d5 <5>4D
	20512.0	20341.0	171.0	98% 3d5 <5>4G
	21823.0	22028.0	-205.0	95% 3d5 <3>4P
	25047.0	25146.0	-99.0	85% 3d5 <5>4D + 12% 3d4 4s (<4>5D)4D
	30864.0	30980.0	-116.0	61% 3d4 4s (<4>3F)4F + 20% 3d5 <3>4F
	31117.0	31426.0	-309.0	53% 3d5 <5>2D + 17% 3d5 <1>2D
	31351.0	31558.0	-207.0	53% 3d4 4s (<4>3P)4P + 34% 3d4 4s (<2>3P)4P
	32603.0	32805.0	-202.0	77% 3d5 <3>2F + 10% 3d5 <5>2D
	32855.0	33093.0	-238.0	53% 3d5 <3>4F + 31% 3d4 4s (<4>3G)4G
	33418.0	33236.0	182.0	64% 3d4 4s (<4>3G)4G + 23% 3d5 <3>4F
	35569.0	35076.0	493.0	59% 3d4 4s (<4>3F)2F + 20% 3d5 <5>2F
	38315.0	38964.0	-649.0	99% 3d4 4s (<4>3D)4D
	39742.0	39974.0	-232.0	75% 3d5 <5>2F + 16% 3d4 4s (<4>3F)2F
	42898.0	43266.0	-368.0	73% 3d4 4s (<4>3D)2D + 16% 3d5 <3>2D
	45731.0	45275.0	456.0	64% 3d4 4s (<4>1D)2D + 16% 3d4 4s (<2>1D)2D
	47354.0	47545.0	-191.0	75% 3d5 <3>2D + 9% 3d4 4s (<4>1D)2D
	50688.0	50510.0	178.0	97% 3d4 4s (<4>1F)2F
	54884.0	54991.0	-107.0	78% 3d4 4s (<2>3F)4F + 21% 3d4 4s (<4>3F)4F
	55023.0	55285.0	-262.0	61% 3d4 4s (<2>3P)4P + 38% 3d4 4s (<4>3P)4P
	59578.0	59799.0	-221.0	77% 3d4 4s (<2>3F)2F + 22% 3d4 4s (<4>3F)2F
	-	67310.0	-	72% 3d5 <1>2D + 24% 3d5 <5>2D
	-	78295.0	-	77% 3d4 4s (<2>1D)2D + 22% 3d4 4s (<4>1D)2D
	86654.0	86253.0	401.0	99% 3d4 4d (<4>5D)6G
	86692.0	86389.0	303.0	96% 3d4 4d (<4>5D)6P
	87515.0	87174.0	341.0	54% 3d4 4d (<4>5D)6D + 43% 3d4 4d (<4>5D)6F
	87759.0	87420.0	339.0	56% 3d4 4d (<4>5D)6F + 43% 3d4 4d (<4>5D)6D
	89056.0	89395.0	-339.0	94% 3d4 4d (<4>5D)4G
	89337.0	89959.0	-622.0	70% 3d4 4d (<4>5D)4P + 24% 3d4 4d (<4>5D)4D
	89812.0	90315.0	-503.0	69% 3d4 4d (<4>5D)4D + 24% 3d4 4d (<4>5D)4P
	90609.0	91261.0	-652.0	92% 3d4 4d (<4>5D)4F
	-	97698.0	-	100% 3d4 4d (<4>5D)6S
	-	105165.0	-	62% 3d4 4d (<4>3H)4F + 22% 3d4 4d (<4>3G)4F
	-	105562.0	-	67% 3d4 4d (<4>3H)2F + 16% 3d4 4d (<4>3P)2F
	-	105737.0	-	54% 3d4 4d (<4>3H)4G + 24% 3d4 4d (<4>3F)4G
	-	105973.0	-	21% 3d4 4d (<4>3P)4F + 20% 3d4 4d (<4>3P)4D
	-	106273.0	-	26% 3d4 4d (<4>3P)4F + 17% 3d4 4d (<4>3F)4D
	-	106666.0	-	30% 3d4 4d (<4>3P)4P + 20% 3d4 4d (<4>3F)4P
	-	106856.0	-	44% 3d4 4d (<4>3G)4G + 30% 3d4 4d (<4>3F)4G
	-	107132.0	-	60% 3d4 4d (<4>3F)4F + 10% 3d4 4d (<2>3F)4F
	-	107362.0	-	41% 3d4 4d (<4>3P)2D + 16% 3d4 4d (<2>3P)2D
	-	107444.0	-	27% 3d4 4d (<4>3G)4D + 18% 3d4 4d (<4>3P)4D
	-	107772.0	-	52% 3d4 4d (<4>3F)2F + 22% 3d4 4d (<4>3G)2F
	-	108737.0	-	43% 3d4 4d (<4>3G)2F + 17% 3d4 4d (<4>3F)2F
	-	109090.0	-	81% 3d4 4d (<4>3G)2D + 13% 3d4 4d (<4>3D)2D
	-	110401.0	-	48% 3d4 4d (<4>3G)4F + 21% 3d4 4d (<4>3D)4F
	-	110684.0	-	37% 3d4 4d (<4>3F)2D + 14% 3d4 4d (<4>1G)2D
	-	110892.0	-	34% 3d4 4d (<4>3G)4D + 33% 3d4 4d (<4>3D)4D
	-	111048.0	-	23% 3d4 4d (<4>3P)2F + 19% 3d4 4d (<4>3G)2F
	-	111480.0	-	39% 3d4 4d (<4>3D)4P + 32% 3d4 4d (<4>3F)4P
	-	112339.0	-	54% 3d4 4d (<4>3D)4G + 22% 3d4 4d (<4>3G)4G
	-	114135.0	-	75% 3d4 4d (<4>3D)4F + 16% 3d4 4d (<4>3G)4F
	-	114563.0	-	60% 3d4 4d (<4>3D)2F + 18% 3d4 4d (<4>1G)2F

	-	116004.0	-	42% 3d4 4d (<4>3D)4G + 23% 3d4 4d (<4>3H)4G
	-	116212.0	-	40% 3d4 4d (<4>3D)2D + 19% 3d4 4d (<4>1G)2D
	-	116770.0	-	27% 3d4 4d (<4>1S)2D + 25% 3d4 4d (<4>1G)2D
	-	117328.0	-	56% 3d4 4d (<4>3D)4P + 20% 3d4 4d (<4>3F)4P
	-	118207.0	-	57% 3d4 4d (<4>3D)4D + 20% 3d4 4d (<4>3G)4D
	-	120305.0	-	42% 3d4 4d (<4>1D)2F + 16% 3d4 4d (<4>1F)2F
	-	120947.0	-	39% 3d4 4d (<4>1S)2D + 22% 3d4 4d (<4>1F)2D
	-	124105.0	-	22% 3d4 4d (<4>1G)2F + 18% 3d4 4d (<4>1D)2F
	-	124785.0	-	38% 3d4 4d (<4>1D)2D + 13% 3d4 4d (<4>3F)2D
	-	127561.0	-	48% 3d4 4d (<4>1F)2F + 15% 3d4 4d (<2>3F)2F
	-	128074.0	-	46% 3d4 4d (<4>1F)2D + 8% 3d4 4d (<4>1F)2F
	-	129934.0	-	78% 3d4 4d (<2>3F)4G + 20% 3d4 4d (<4>3F)4G
	-	130299.0	-	26% 3d4 4d (<2>3P)4P + 20% 3d4 4d (<2>3F)4P
	-	130446.0	-	53% 3d4 4d (<2>3F)4D + 14% 3d4 4d (<4>3F)4D
	-	130815.0	-	31% 3d4 4d (<2>3P)4D + 21% 3d4 4d (<4>3P)4D
	-	130956.0	-	55% 3d4 4d (<2>3F)2F + 17% 3d4 4d (<4>3F)2F
	-	131126.0	-	37% 3d4 4d (<2>3P)4F + 21% 3d4 4d (<4>3P)4F
	-	132790.0	-	45% 3d4 4d (<2>3P)2F + 23% 3d4 4d (<4>3P)2F
	-	133003.0	-	49% 3d4 4d (<2>3F)4P + 32% 3d4 4d (<2>3P)4P
	-	133185.0	-	32% 3d4 4d (<2>3P)2D + 15% 3d4 4d (<4>3P)2D
	-	135300.0	-	65% 3d4 4d (<2>3F)4F + 14% 3d4 4d (<2>3P)4F
	-	135799.0	-	57% 3d4 4d (<2>3F)2D + 15% 3d4 4d (<2>1G)2D
	-	138123.0	-	64% 3d4 4d (<2>1G)2F + 30% 3d4 4d (<4>1G)2F
	-	145337.0	-	37% 3d4 4d (<2>1G)2D + 17% 3d4 4d (<2>3P)2D
	-	153062.0	-	79% 3d4 4d (<2>1D)2F + 20% 3d4 4d (<4>1D)2F
	-	155751.0	-	73% 3d4 4d (<2>1D)2D + 16% 3d4 4d (<4>1D)2D
	-	173946.0	-	81% 3d4 4d (<0>1S)2D + 18% 3d4 4d (<4>1S)2D
7/2	12304.0	12754.0	-450.0	100% 3d4 4s (<4>5D)6D
	20024.0	20060.0	-36.0	87% 3d4 4s (<4>5D)4D + 13% 3d5 <5>4D
	20518.0	20351.0	167.0	98% 3d5 <5>4G
	25034.0	25143.0	-109.0	85% 3d5 <5>4D + 13% 3d4 4s (<4>5D)4D
	30157.0	29081.0	1076.0	100% 3d4 4s (<4>3H)4H
	31169.0	31023.0	146.0	62% 3d4 4s (<4>3F)4F + 20% 3d5 <3>4F
	32356.0	32636.0	-280.0	96% 3d5 <3>2F
	32837.0	33083.0	-246.0	65% 3d5 <3>4F + 19% 3d4 4s (<4>3G)4G
	33521.0	33344.0	177.0	78% 3d4 4s (<4>3G)4G + 12% 3d5 <3>4F
	35608.0	35077.0	531.0	59% 3d4 4s (<4>3F)2F + 21% 3d5 <5>2F
	36102.0	35261.0	841.0	66% 3d5 <5>2G + 23% 3d4 4s (<4>3G)2G
	38270.0	38327.0	-57.0	66% 3d4 4s (<4>3G)2G + 13% 3d4 4s (<4>1G)2G
	38509.0	38924.0	-415.0	99% 3d4 4s (<4>3D)4D
	39877.0	39989.0	-112.0	64% 3d5 <5>2F + 14% 3d4 4s (<4>3F)2F
	39684.0	40286.0	-602.0	40% 3d4 4s (<4>1G)2G + 22% 3d4 4s (<2>1G)2G
	50667.0	50488.0	179.0	97% 3d4 4s (<4>1F)2F
	52298.0	52130.0	168.0	96% 3d5 <3>2G
	54888.0	54981.0	-93.0	78% 3d4 4s (<2>3F)4F + 21% 3d4 4s (<4>3F)4F
	59570.0	59769.0	-199.0	78% 3d4 4s (<2>3F)2F + 21% 3d4 4s (<4>3F)2F
	-	61910.0	-	65% 3d4 4s (<2>1G)2G + 34% 3d4 4s (<4>1G)2G
	86738.0	86341.0	397.0	99% 3d4 4d (<4>5D)6G
	86782.0	86482.0	300.0	96% 3d4 4d (<4>5D)6P
	87588.0	87250.0	338.0	53% 3d4 4d (<4>5D)6D + 43% 3d4 4d (<4>5D)6F
	87859.0	87529.0	330.0	55% 3d4 4d (<4>5D)6F + 43% 3d4 4d (<4>5D)6D
	89174.0	89524.0	-350.0	94% 3d4 4d (<4>5D)4G
	89885.0	90368.0	-483.0	93% 3d4 4d (<4>5D)4D
	90726.0	91391.0	-665.0	92% 3d4 4d (<4>5D)4F
	103949.0	103748.0	201.0	98% 3d4 4d (<4>3H)4H
	-	104466.0	-	76% 3d4 4d (<4>3H)2G + 15% 3d4 4d (<4>3G)2G
	105199.0	105191.0	8.0	62% 3d4 4d (<4>3H)4F + 23% 3d4 4d (<4>3G)4F
	-	105794.0	-	53% 3d4 4d (<4>3H)4G + 26% 3d4 4d (<4>3F)4G
	-	105842.0	-	64% 3d4 4d (<4>3H)2F + 14% 3d4 4d (<4>3P)2F
	-	106202.0	-	22% 3d4 4d (<4>3P)4D + 14% 3d4 4d (<4>3P)4F
	-	106331.0	-	73% 3d4 4d (<4>3F)4H + 19% 3d4 4d (<2>3F)4H
	-	106472.0	-	29% 3d4 4d (<4>3P)4F + 20% 3d4 4d (<4>3F)4D
	-	106962.0	-	39% 3d4 4d (<4>3G)4G + 25% 3d4 4d (<4>3F)4G
	-	107261.0	-	53% 3d4 4d (<4>3F)4F + 13% 3d4 4d (<4>3G)4G
	-	107396.0	-	35% 3d4 4d (<4>3G)4D + 25% 3d4 4d (<4>3P)4D
	-	107796.0	-	60% 3d4 4d (<4>3G)4H + 15% 3d4 4d (<4>3F)2G
	107830.0	107984.0	-154.0	46% 3d4 4d (<4>3F)2F + 17% 3d4 4d (<4>3G)4H
	-	108233.0	-	44% 3d4 4d (<4>3F)2G + 13% 3d4 4d (<4>3G)4H
	-	108941.0	-	54% 3d4 4d (<4>3G)2F + 10% 3d4 4d (<4>3P)2F
	-	110513.0	-	50% 3d4 4d (<4>3G)4F + 24% 3d4 4d (<4>3D)4F
	-	111054.0	-	36% 3d4 4d (<4>3D)4D + 33% 3d4 4d (<4>3G)4D
	-	111285.0	-	25% 3d4 4d (<4>3P)2F + 16% 3d4 4d (<4>3G)2F
	-	112296.0	-	48% 3d4 4d (<4>3D)4G + 18% 3d4 4d (<4>3G)4G
	-	112473.0	-	31% 3d4 4d (<4>3G)2G + 14% 3d4 4d (<4>1I)2G
	-	113813.0	-	39% 3d4 4d (<4>3D)2G + 26% 3d4 4d (<4>1I)2G
	-	114175.0	-	73% 3d4 4d (<4>3D)4F + 17% 3d4 4d (<4>3G)4F
	-	114656.0	-	55% 3d4 4d (<4>3D)2F + 18% 3d4 4d (<4>1G)2F
	-	115986.0	-	41% 3d4 4d (<4>3D)4G + 23% 3d4 4d (<4>3H)4G
	-	116584.0	-	33% 3d4 4d (<4>1G)2G + 23% 3d4 4d (<2>1G)2G
	-	117426.0	-	41% 3d4 4d (<4>1I)2G + 32% 3d4 4d (<4>3D)2G
	-	118161.0	-	58% 3d4 4d (<4>3D)4D + 22% 3d4 4d (<4>3G)4D
	-	120385.0	-	41% 3d4 4d (<4>1D)2F + 16% 3d4 4d (<4>1F)2F
	-	121675.0	-	55% 3d4 4d (<4>1D)2G + 20% 3d4 4d (<4>1F)2G
	-	123992.0	-	25% 3d4 4d (<4>1G)2F + 21% 3d4 4d (<4>1D)2F
	-	126720.0	-	63% 3d4 4d (<4>1F)2G + 14% 3d4 4d (<2>3F)2G

	-	127476.0	-	53% 3d4 4d (<4>1F)2F + 19% 3d4 4d (<2>3F)2F
	-	129934.0	-	78% 3d4 4d (<2>3F)4G + 20% 3d4 4d (<4>3F)4G
	-	130371.0	-	80% 3d4 4d (<2>3F)4H + 20% 3d4 4d (<4>3F)4H
	-	130372.0	-	57% 3d4 4d (<2>3F)4D + 17% 3d4 4d (<2>3P)4D
	-	130696.0	-	29% 3d4 4d (<2>3P)4D + 19% 3d4 4d (<4>3P)4D
	-	130982.0	-	34% 3d4 4d (<2>3P)4F + 19% 3d4 4d (<4>3P)4F
	-	131058.0	-	50% 3d4 4d (<2>3F)2F + 17% 3d4 4d (<4>1F)2F
	-	132547.0	-	56% 3d4 4d (<2>3P)2F + 29% 3d4 4d (<4>3P)2F
	-	134139.0	-	43% 3d4 4d (<2>3F)2G + 19% 3d4 4d (<4>3F)2G
	-	135262.0	-	66% 3d4 4d (<2>3F)4F + 13% 3d4 4d (<2>3P)4F
	-	138176.0	-	63% 3d4 4d (<2>1G)2F + 29% 3d4 4d (<4>1G)2F
	-	141286.0	-	46% 3d4 4d (<2>1G)2G + 24% 3d4 4d (<4>1G)2G
	-	153072.0	-	79% 3d4 4d (<2>1D)2F + 20% 3d4 4d (<4>1D)2F
	-	153616.0	-	77% 3d4 4d (<2>1D)2G + 18% 3d4 4d (<4>1D)2G
9/2	12496.0	12965.0	-469.0	100% 3d4 4s (<4>5D)6D
	20519.0	20358.0	161.0	98% 3d5 <5>4G
	30219.0	29157.0	1062.0	99% 3d4 4s (<4>3H)4H
	31219.0	31064.0	155.0	61% 3d4 4s (<4>3F)4F + 21% 3d5 <3>4F
	32854.0	33110.0	-256.0	69% 3d5 <3>4F + 12% 3d4 4s (<4>3G)4G
	33619.0	33415.0	204.0	68% 3d4 4s (<4>3G)4G + 16% 3d4 4s (<4>3H)2H
	34631.0	33585.0	1046.0	71% 3d4 4s (<4>3H)2H + 17% 3d4 4s (<4>3G)4G
	35610.0	35358.0	252.0	64% 3d5 <5>2G + 18% 3d4 4s (<4>3G)2G
	36273.0	35862.0	411.0	83% 3d5 <3>2H + 7% 3d4 4s (<4>3H)2H
	38563.0	38370.0	193.0	65% 3d4 4s (<4>3G)2G + 18% 3d4 4s (<4>1G)2G
	39824.0	40332.0	-508.0	41% 3d4 4s (<4>1G)2G + 24% 3d4 4s (<2>1G)2G
	52321.0	52121.0	200.0	96% 3d5 <3>2G
	54868.0	54940.0	-72.0	79% 3d4 4s (<2>3F)4F + 21% 3d4 4s (<4>3F)4F
	-	61902.0	-	66% 3d4 4s (<2>1G)2G + 34% 3d4 4s (<4>1G)2G
	86847.0	86456.0	391.0	99% 3d4 4d (<4>5D)6G
	87688.0	87357.0	331.0	62% 3d4 4d (<4>5D)6D + 38% 3d4 4d (<4>5D)6F
	87949.0	87622.0	327.0	61% 3d4 4d (<4>5D)6F + 38% 3d4 4d (<4>5D)6D
	89325.0	89690.0	-365.0	94% 3d4 4d (<4>5D)4G
	90851.0	91536.0	-685.0	93% 3d4 4d (<4>5D)4F
	103755.0	103514.0	241.0	95% 3d4 4d (<4>3H)4I + 4% 3d4 4d (<4>3G)4I
	104024.0	103828.0	196.0	98% 3d4 4d (<4>3H)4H
	-	104494.0	-	73% 3d4 4d (<4>3H)2G + 16% 3d4 4d (<4>3G)2G
	105255.0	105258.0	-3.0	62% 3d4 4d (<4>3H)4F + 23% 3d4 4d (<4>3G)4F
	-	105590.0	-	69% 3d4 4d (<4>3H)2H + 18% 3d4 4d (<4>3F)2H
	-	105873.0	-	54% 3d4 4d (<4>3H)4G + 29% 3d4 4d (<4>3F)4G
	-	106388.0	-	73% 3d4 4d (<4>3F)4H + 19% 3d4 4d (<2>3F)4H
	-	106687.0	-	39% 3d4 4d (<4>3P)4F + 23% 3d4 4d (<2>3P)4F
	106924.0	107133.0	-209.0	36% 3d4 4d (<4>3G)4G + 20% 3d4 4d (<4>3F)4G
	-	107381.0	-	46% 3d4 4d (<4>3F)4F + 15% 3d4 4d (<4>3G)4G
	-	107573.0	-	73% 3d4 4d (<4>3G)4I + 8% 3d4 4d (<4>3G)4H
	107707.0	107970.0	-263.0	31% 3d4 4d (<4>3G)4H + 17% 3d4 4d (<4>3G)4I
	-	107979.0	-	44% 3d4 4d (<4>3G)4H + 21% 3d4 4d (<4>3G)2H
	107922.0	108269.0	-347.0	41% 3d4 4d (<4>3F)2G + 11% 3d4 4d (<4>3F)2H
	-	109849.0	-	45% 3d4 4d (<4>3G)2H + 25% 3d4 4d (<4>1I)2H
	-	110641.0	-	51% 3d4 4d (<4>3G)4F + 28% 3d4 4d (<4>3D)4F
	-	112273.0	-	52% 3d4 4d (<4>3D)4G + 20% 3d4 4d (<4>3G)4G
	-	112526.0	-	30% 3d4 4d (<4>3G)2G + 18% 3d4 4d (<4>1I)2G
	-	113764.0	-	39% 3d4 4d (<4>3D)2G + 24% 3d4 4d (<4>1I)2G
	-	114125.0	-	42% 3d4 4d (<4>1G)2H + 35% 3d4 4d (<4>1I)2H
	-	114241.0	-	71% 3d4 4d (<4>3D)4F + 18% 3d4 4d (<4>3G)4F
	-	115971.0	-	41% 3d4 4d (<4>3D)4G + 23% 3d4 4d (<4>3H)4G
	-	116740.0	-	30% 3d4 4d (<4>1G)2G + 23% 3d4 4d (<2>1G)2G
	-	117504.0	-	41% 3d4 4d (<4>1I)2G + 31% 3d4 4d (<4>3D)2G
	-	119516.0	-	32% 3d4 4d (<4>1I)2H + 29% 3d4 4d (<4>1G)2H
	-	121645.0	-	56% 3d4 4d (<4>1D)2G + 19% 3d4 4d (<4>1F)2G
	-	124985.0	-	90% 3d4 4d (<4>1F)2H
	-	126842.0	-	65% 3d4 4d (<4>1F)2G + 11% 3d4 4d (<2>3F)2G
	-	129932.0	-	79% 3d4 4d (<2>3F)4G + 20% 3d4 4d (<4>3F)4G
	-	130379.0	-	80% 3d4 4d (<2>3F)4H + 19% 3d4 4d (<4>3F)4H
	-	130716.0	-	52% 3d4 4d (<2>3P)4F + 28% 3d4 4d (<4>3P)4F
	-	132314.0	-	75% 3d4 4d (<2>3F)2H + 12% 3d4 4d (<4>3F)2H
	-	134045.0	-	45% 3d4 4d (<2>3F)2G + 19% 3d4 4d (<4>3F)2G
	-	135209.0	-	67% 3d4 4d (<2>3F)4F + 12% 3d4 4d (<2>3P)4F
	-	138518.0	-	70% 3d4 4d (<2>1G)2H + 20% 3d4 4d (<4>1G)2H
	-	141282.0	-	47% 3d4 4d (<2>1G)2G + 24% 3d4 4d (<4>1G)2G
	-	153605.0	-	77% 3d4 4d (<2>1D)2G + 18% 3d4 4d (<4>1D)2G
11/2	20512.0	20357.0	155.0	98% 3d5 <5>4G
	30299.0	29251.0	1048.0	100% 3d4 4s (<4>3H)4H
	30143.0	30110.0	33.0	99% 3d5 <5>2I
	33694.0	33444.0	250.0	80% 3d4 4s (<4>3G)4G + 17% 3d4 4s (<4>3H)2H
	34813.0	33823.0	990.0	71% 3d4 4s (<4>3H)2H + 19% 3d4 4s (<4>3G)4G
	35707.0	35880.0	-173.0	87% 3d5 <3>2H + 12% 3d4 4s (<4>3H)2H
	-	38332.0	-	99% 3d4 4s (<4>1I)2I
	86980.0	86599.0	381.0	99% 3d4 4d (<4>5D)6G
	88001.0	87657.0	344.0	99% 3d4 4d (<4>5D)6F
	89509.0	89894.0	-385.0	94% 3d4 4d (<4>5D)4G
	103843.0	103606.0	237.0	94% 3d4 4d (<4>3H)4I
	104106.0	103918.0	188.0	98% 3d4 4d (<4>3H)4H
	104460.0	103992.0	468.0	99% 3d4 4d (<4>3H)4K
	-	105750.0	-	69% 3d4 4d (<4>3H)2H + 20% 3d4 4d (<4>3F)2H

	105338.0	105957.0	-619.0	53% 3d4 4d (<4>3H)4G + 33% 3d4 4d (<4>3F)4G
	-	106354.0	-	72% 3d4 4d (<4>3H)2I + 12% 3d4 4d (<4>3G)2I
	106145.0	106455.0	-310.0	74% 3d4 4d (<4>3F)4H + 18% 3d4 4d (<2>3F)4H
	-	107389.0	-	53% 3d4 4d (<4>3G)4G + 27% 3d4 4d (<4>3F)4G
	-	107713.0	-	79% 3d4 4d (<4>3G)4I + 12% 3d4 4d (<4>3G)4H
	108018.0	108098.0	-80.0	71% 3d4 4d (<4>3G)4H + 7% 3d4 4d (<4>3G)2H
	107761.0	108148.0	-387.0	32% 3d4 4d (<4>3G)2H + 30% 3d4 4d (<4>3F)2H
	-	109210.0	-	74% 3d4 4d (<4>3G)2I + 20% 3d4 4d (<4>1I)2I
	-	109937.0	-	45% 3d4 4d (<4>3G)2H + 26% 3d4 4d (<4>1I)2H
	-	112252.0	-	55% 3d4 4d (<4>3D)4G + 23% 3d4 4d (<4>3G)4G
	-	114158.0	-	43% 3d4 4d (<4>1G)2H + 33% 3d4 4d (<4>1I)2H
	-	114361.0	-	56% 3d4 4d (<4>1G)2I + 24% 3d4 4d (<2>1G)2I
	-	115951.0	-	43% 3d4 4d (<4>3D)4G + 23% 3d4 4d (<4>3H)4G
	-	119491.0	-	32% 3d4 4d (<4>1I)2H + 28% 3d4 4d (<4>1G)2H
	-	121377.0	-	51% 3d4 4d (<4>1I)2I + 20% 3d4 4d (<4>3H)2I
	-	125142.0	-	90% 3d4 4d (<4>1F)2H
	-	129913.0	-	80% 3d4 4d (<2>3F)4G + 19% 3d4 4d (<4>3F)4G
	-	130378.0	-	80% 3d4 4d (<2>3F)4H + 19% 3d4 4d (<4>3F)4H
	-	132199.0	-	76% 3d4 4d (<2>3F)2H + 12% 3d4 4d (<4>3F)2H
	-	136870.0	-	68% 3d4 4d (<2>1G)2I + 31% 3d4 4d (<4>1G)2I
	-	138521.0	-	70% 3d4 4d (<2>1G)2H + 20% 3d4 4d (<4>1G)2H
13/2	30392.0	29363.0	1029.0	100% 3d4 4s (<4>3H)4H
	30150.0	30136.0	14.0	99% 3d5 <5>2I
	-	38324.0	-	100% 3d4 4s (<4>1I)2I
	87137.0	86769.0	368.0	100% 3d4 4d (<4>5D)6G
	103948.0	103718.0	230.0	94% 3d4 4d (<4>3H)4I
	104191.0	104015.0	176.0	98% 3d4 4d (<4>3H)4H
	104540.0	104077.0	463.0	98% 3d4 4d (<4>3H)4K
	105125.0	104729.0	396.0	98% 3d4 4d (<4>3H)2K
	105434.0	106532.0	-1098.0	76% 3d4 4d (<4>3F)4H + 18% 3d4 4d (<2>3F)4H
	106343.0	106542.0	-199.0	73% 3d4 4d (<4>3H)2I + 14% 3d4 4d (<4>3G)2I
	107847.0	107842.0	5.0	85% 3d4 4d (<4>3G)4I + 11% 3d4 4d (<4>3G)4H
	108104.0	108188.0	-84.0	86% 3d4 4d (<4>3G)4H + 8% 3d4 4d (<4>3G)4I
	-	109473.0	-	71% 3d4 4d (<4>3G)2I + 23% 3d4 4d (<4>1I)2I
	-	112558.0	-	100% 3d4 4d (<4>1I)2K
	-	114397.0	-	59% 3d4 4d (<4>1G)2I + 25% 3d4 4d (<2>1G)2I
	-	121331.0	-	52% 3d4 4d (<4>1I)2I + 21% 3d4 4d (<4>3H)2I
	-	130357.0	-	81% 3d4 4d (<2>3F)4H + 19% 3d4 4d (<4>3F)4H
	-	136877.0	-	69% 3d4 4d (<2>1G)2I + 31% 3d4 4d (<4>1G)2I
15/2	104070.0	103851.0	219.0	96% 3d4 4d (<4>3H)4I
	104633.0	104180.0	453.0	98% 3d4 4d (<4>3H)4K
	105285.0	104912.0	373.0	99% 3d4 4d (<4>3H)2K
	107982.0	107952.0	30.0	97% 3d4 4d (<4>3G)4I
	-	112570.0	-	100% 3d4 4d (<4>1I)2K
	-	112995.0	-	100% 3d4 4d (<4>1I)2L
17/2	104734.0	104299.0	435.0	100% 3d4 4d (<4>3H)4K
	-	113017.0	-	100% 3d4 4d (<4>1I)2L

Table IV.

Observed and least squares fitted energy levels of odd parity configurations of Cr II in cm^{-1}:

1

J	E(obs)	E(LSF)	diff.	LS-composition.
1/2	46823.0	47313.0	-490.0	100% 3d4 4p (<4>5D)6F
	48749.0	49041.0	-292.0	86% 3d4 4p (<4>5D)4P + 11% 3d4 4p (<4>5D)6D
	49493.0	49915.0	-422.0	89% 3d4 4p (<4>5D)6D + 11% 3d4 4p (<4>5D)4P
	54418.0	54512.0	-94.0	96% 3d4 4p (<4>5D)4D
	63802.0	64487.0	-685.0	48% 3d4 4p (<4>3P)4D + 32% 3d4 4p (<2>3P)4D
	65029.0	65887.0	-858.0	40% 3d4 4p (<2>3P)2S + 38% 3d4 4p (<4>3P)2S
	66256.0	66756.0	-500.0	52% 3d4 4p (<4>3P)4P + 30% 3d4 4p (<2>3P)4P
	66872.0	67518.0	-646.0	50% 3d4 4p (<4>3P)2P + 23% 3d4 4p (<2>3P)2P
	67860.0	67894.0	-34.0	54% 3d4 4p (<4>3F)4D + 16% 3d4 4p (<2>3F)4D
	73407.0	74142.0	-735.0	95% 3d4 4p (<4>3D)4D
	74854.0	75039.0	-185.0	94% 3d4 4p (<4>3D)4P
	74920.0	76035.0	-1115.0	76% 3d4 4p (<4>3D)2P + 15% 3d4 4p (<4>1S)2P
	77777.0	78664.0	-887.0	52% 3d4 4p (<4>1S)2P + 15% 3d4 4p (<0>1S)2P
	81649.0	81400.0	249.0	96% 3d3 4s 4p ((<3>4F)5F)6D
	81735.0	81832.0	-97.0	99% 3d3 4s 4p ((<3>4F)5F)6F
	82854.0	82467.0	387.0	64% 3d4 4p (<4>1D)2P + 14% 3d4 4p (<2>1D)2P
	85486.0	85531.0	-45.0	47% 3d3 4s 4p ((<3>4F)3F)4D + 43% 3d3 4s 4p ((<3>4F)5F)4D
	89508.0	90250.0	-742.0	58% 3d4 4p (<2>3P)4P + 30% 3d4 4p (<4>3P)4P
	90475.0	90801.0	-326.0	35% 3d4 4p (<2>3F)4D + 32% 3d4 4p (<2>3P)4D
	93800.0	94338.0	-538.0	36% 3d4 4p (<2>3F)4D + 26% 3d4 4p (<2>3P)4D
	93969.0	94518.0	-549.0	95% 3d3 4s 4p ((<3>4P)5P)6D
	94625.0	94558.0	67.0	56% 3d4 4p (<2>3P)2P + 25% 3d4 4p (<4>3P)2P
	96245.0	96931.0	-686.0	49% 3d4 4p (<4>3P)2S + 48% 3d4 4p (<2>3P)2S
	97168.0	97649.0	-481.0	41% 3d3 4s 4p ((<3>4P)3P)4P + 34% 3d3 4s 4p ((<3>4P)5P)4P
	-	99853.0	-	63% 3d3 4s 4p ((<3>2P)3P)4P + 19% 3d3 4s 4p ((<3>2D)3D)4P
	-	100481.0	-	63% 3d3 4s 4p ((<3>2P)3P)4D + 8% 3d3 4s 4p ((<3>4F)3F)4D
	-	100891.0	-	41% 3d3 4s 4p ((<3>2P)1P)2S + 25% 3d3 4s 4p ((<3>2P)3P)2S
	-	101613.0	-	56% 3d3 4s 4p ((<3>4P)3P)2P + 17% 3d3 4s 4p ((<3>2P)1P)2S
	102620.0	102654.0	-34.0	45% 3d3 4s 4p ((<3>4P)3P)4D + 23% 3d3 4s 4p ((<3>4P)5P)4D
	-	104128.0	-	53% 3d3 4s 4p ((<3>2D)3D)4D + 10% 3d3 4s 4p ((<1>2D)3D)4D
	-	104462.0	-	18% 3d4 4f (<4>3H)4D + 14% 3d4 4f (<2>1G)2P
	-	104599.0	-	11% 3d4 4f (<4>3G)2P + 9% 3d3 4s 4p ((<3>2D)1D)2P
	-	104735.0	-	11% 3d4 4f (<2>3F)2S + 11% 3d4 4f (<4>3D)4P
	-	104808.0	-	16% 3d4 4f (<2>3F)4P + 14% 3d4 4f (<4>3G)4P
	-	104865.0	-	20% 3d4 4f (<4>5D)6F + 13% 3d4 4f (<2>3F)4D
	-	105132.0	-	21% 3d3 4s 4p ((<3>2D)3D)4P + 19% 3d4 4f (<4>3G)4P
	-	105150.0	-	17% 3d4 4f (<4>3H)4D + 13% 3d4 4f (<4>5D)4P
	-	105250.0	-	42% 3d4 4f (<4>5D)6F + 11% 3d4 4f (<4>1D)2P
	-	105272.0	-	37% 3d4 4f (<4>5D)4D + 14% 3d4 4f (<4>3F)4D
	105392.0	105295.0	97.0	27% 3d4 4f (<4>5D)6D + 20% 3d4 4f (<4>3G)2P
	-	105340.0	-	20% 3d4 4f (<4>3F)4D + 11% 3d4 4f (<4>3G)4D
	-	105383.0	-	30% 3d4 4f (<4>1G)2P + 15% 3d4 4f (<4>3G)2P
	-	105404.0	-	29% 3d4 4f (<4>3P)4D + 13% 3d4 4f (<4>3F)2P
	-	105465.0	-	21% 3d4 4f (<2>3F)2S + 18% 3d4 4f (<2>3P)4D
	-	105528.0	-	14% 3d4 4f (<4>3F)4P + 13% 3d3 4s 4p ((<3>2D)3D)4P
	-	105538.0	-	16% 3d4 4f (<4>3F)2P + 12% 3d4 4f (<2>3F)2P
	-	105583.0	-	48% 3d4 4f (<2>1D)2P + 14% 3d4 4f (<4>3P)4D
	-	105822.0	-	22% 3d4 4f (<4>5D)4P + 13% 3d4 4f (<4>5D)4D
	-	105890.0	-	16% 3d4 4f (<4>5D)4P + 15% 3d4 4f (<4>3F)2S
	-	105905.0	-	24% 3d4 4f (<4>3F)4P + 21% 3d4 4f (<4>5D)6D
	-	105970.0	-	24% 3d4 4f (<4>1F)2P + 17% 3d4 4f (<4>3D)4P
	-	106014.0	-	13% 3d4 4f (<4>1F)2S + 13% 3d4 4f (<4>1F)2P
	-	106033.0	-	15% 3d4 4f (<4>1F)2S + 11% 3d4 4f (<4>3D)4P
	-	106069.0	-	15% 3d4 4f (<2>3F)4D + 14% 3d4 4f (<2>3P)4D
	-	106109.0	-	14% 3d4 4f (<2>3F)4D + 14% 3d4 4f (<4>1F)2P
	-	106137.0	-	21% 3d4 4f (<2>3F)4P + 17% 3d4 4f (<4>1F)2S
	-	106190.0	-	15% 3d4 4f (<4>3F)2P + 13% 3d4 4f (<4>1D)2P
	-	106531.0	-	12% 3d4 4f (<2>3F)2P + 10% 3d4 4f (<4>5D)4P
	-	106660.0	-	18% 3d4 4f (<2>1D)2P + 15% 3d4 4f (<4>3D)4D
	-	107226.0	-	37% 3d3 4s 4p ((<3>4F)5F)4D + 31% 3d3 4s 4p ((<3>4F)3F)4D
	-	109265.0	-	43% 3d3 4s 4p ((<3>2P)1P)2P + 17% 3d3 4s 4p ((<3>2D)1D)2P
	-	112307.0	-	93% 3d3 4s 4p ((<3>4P)3P)2S
	-	112817.0	-	62% 3d4 4p (<2>1D)2P + 16% 3d4 4p (<4>1D)2P
	-	117140.0	-	86% 3d3 4s 4p ((<3>2F)3F)4D + 7% 3d3 4s 4p ((<1>2D)3D)4D
	118661.0	118436.0	225.0	53% 3d3 4s 4p ((<3>4P)5P)4P + 42% 3d3 4s 4p ((<3>4P)3P)4P
	-	121495.0	-	55% 3d3 4s 4p ((<3>4P)5P)4D + 29% 3d3 4s 4p ((<3>4P)3P)4D
	-	123073.0	-	39% 3d3 4s 4p ((<3>2P)3P)2P + 21% 3d3 4s 4p ((<3>2D)3D)2P
	-	124836.0	-	58% 3d3 4s 4p ((<3>2P)3P)2S + 35% 3d3 4s 4p ((<3>2P)1P)2S
	-	128849.0	-	33% 3d3 4s 4p ((<3>2P)3P)2P + 30% 3d3 4s 4p ((<3>2D)3D)2P
	-	131431.0	-	76% 3d3 4s 4p ((<1>2D)3D)4D + 18% 3d3 4s 4p ((<3>2D)3D)4D
	-	133163.0	-	70% 3d4 4p (<0>1S)2P + 20% 3d4 4p (<4>1S)2P
	-	136365.0	-	75% 3d3 4s 4p ((<1>2D)3D)4P + 24% 3d3 4s 4p ((<3>2D)3D)4P
	-	142307.0	-	60% 3d3 4s 4p ((<1>2D)1D)2P + 18% 3d3 4s 4p ((<3>2D)1D)2P
	-	160326.0	-	57% 3d3 4s 4p ((<1>2D)3D)2P + 19% 3d3 4s 4p ((<3>2D)3D)2P

3/2	46905.0	47388.0	-483.0	100% 3d4 4p	(<4>5D)6F		
	48399.0	48175.0	224.0	99% 3d4 4p	(<4>5D)6P		
	49006.0	49283.0	-277.0	85% 3d4 4p	(<4>5D)4P	+ 12% 3d4 4p	(<4>5D)6D
	49565.0	49977.0	-412.0	87% 3d4 4p	(<4>5D)6D	+ 12% 3d4 4p	(<4>5D)4P
	51584.0	51779.0	-195.0	96% 3d4 4p	(<4>5D)4F		
	54500.0	54602.0	-102.0	96% 3d4 4p	(<4>5D)4D		
	64062.0	64705.0	-643.0	47% 3d4 4p	(<4>3P)4D	+ 31% 3d4 4p	(<2>3P)4D
	66355.0	66823.0	-468.0	56% 3d4 4p	(<4>3P)4P	+ 32% 3d4 4p	(<2>3P)4P
	66649.0	67069.0	-420.0	44% 3d4 4p	(<4>3F)4F	+ 22% 3d4 4p	(<4>3F)2D
	67070.0	67437.0	-367.0	30% 3d4 4p	(<4>3F)4F	+ 21% 3d4 4p	(<4>3F)2D
	67379.0	67680.0	-301.0	36% 3d4 4p	(<4>3P)2P	+ 16% 3d4 4p	(<2>3P)2P
	67870.0	67926.0	-56.0	45% 3d4 4p	(<4>3F)4D	+ 13% 3d4 4p	(<2>3F)4D
	68306.0	68466.0	-160.0	50% 3d4 4p	(<4>3P)4S	+ 40% 3d4 4p	(<2>3P)4S
	69348.0	68917.0	431.0	81% 3d4 4p	(<4>3G)4F	+ 7% 3d4 4p	(<4>3D)4F
	69639.0	69510.0	129.0	48% 3d4 4p	(<4>3P)2D	+ 31% 3d4 4p	(<2>3P)2D
	73412.0	74142.0	-730.0	93% 3d4 4p	(<4>3D)4D		
	74273.0	74907.0	-634.0	90% 3d4 4p	(<4>3D)4P		
	74718.0	74968.0	-250.0	86% 3d4 4p	(<4>3D)4F	+ 7% 3d4 4p	(<4>3G)4F
	74985.0	75984.0	-999.0	78% 3d4 4p	(<4>3D)2P	+ 11% 3d4 4p	(<4>1S)2P
	77713.0	78209.0	-496.0	76% 3d4 4p	(<4>3D)2D	+ 5% 3d4 4p	(<4>1D)2D
	78110.0	78721.0	-611.0	49% 3d4 4p	(<4>1S)2P	+ 14% 3d4 4p	(<0>1S)2P
	-	79251.0	-	100% 3d3 4s 4p	((<3>4F)5F)6G		
	80288.0	79668.0	620.0	63% 3d4 4p	(<4>1D)2D	+ 20% 3d4 4p	(<2>1D)2D
	81708.0	81476.0	232.0	96% 3d3 4s 4p	((<3>4F)5F)6D		
	81824.0	81921.0	-97.0	99% 3d3 4s 4p	((<3>4F)5F)6F		
	82920.0	82578.0	342.0	61% 3d4 4p	(<4>1D)2P	+ 14% 3d4 4p	(<2>1D)2P
	85587.0	85638.0	-51.0	46% 3d3 4s 4p	((<3>4F)3F)4D	+ 43% 3d3 4s 4p	((<3>4F)5F)4D
	86919.0	86897.0	22.0	80% 3d4 4p	(<4>1F)2D	+ 6% 3d4 4p	(<2>3P)2D
	87629.0	87834.0	-205.0	36% 3d3 4s 4p	((<3>4F)3F)4F	+ 30% 3d3 4s 4p	((<3>4F)5F)4F
	88604.0	88549.0	55.0	78% 3d3 4s 4p	((<3>4F)3F)2D	+ 6% 3d3 4s 4p	((<3>4P)3P)2D
	89422.0	90142.0	-720.0	55% 3d4 4p	(<2>3P)4P	+ 28% 3d4 4p	(<4>3P)4P
	90262.0	90369.0	-107.0	57% 3d4 4p	(<2>3F)4F	+ 21% 3d3 4s 4p	((<3>4F)3F)4F
	90451.0	90746.0	-295.0	32% 3d4 4p	(<2>3F)4D	+ 30% 3d4 4p	(<2>3P)4D
	91556.0	91537.0	19.0	32% 3d4 4p	(<2>3P)2D	+ 21% 3d4 4p	(<2>3F)2D
	92235.0	92780.0	-545.0	51% 3d4 4p	(<2>3P)4S	+ 40% 3d4 4p	(<4>3P)4S
	92612.0	92947.0	-335.0	99% 3d3 4s 4p	((<3>4P)5P)6P		
	93770.0	94290.0	-520.0	31% 3d4 4p	(<2>3F)4D	+ 23% 3d4 4p	(<2>3P)4D
	94383.0	94337.0	46.0	49% 3d4 4p	(<2>3P)2P	+ 23% 3d4 4p	(<4>3P)2P
	94098.0	94606.0	-508.0	96% 3d3 4s 4p	((<3>4P)5P)6D		
	97294.0	97800.0	-506.0	43% 3d3 4s 4p	((<3>4P)3P)4P	+ 36% 3d3 4s 4p	((<3>4P)5P)4P
	98315.0	98139.0	176.0	82% 3d3 4s 4p	((<3>2G)3G)4F	+ 8% 3d3 4s 4p	((<3>2D)3D)4F
	98579.0	98259.0	320.0	44% 3d4 4p	(<2>3F)2D	+ 19% 3d4 4p	(<2>3P)2D
	-	99977.0	-	60% 3d3 4s 4p	((<3>2P)3P)4P	+ 21% 3d3 4s 4p	((<3>2D)3D)4P
	100692.0	100654.0	38.0	65% 3d3 4s 4p	((<3>2P)3P)4D	+ 9% 3d3 4s 4p	((<3>4F)3F)4D
	101158.0	101356.0	-198.0	73% 3d3 4s 4p	((<3>4P)3P)2P	+ 6% 3d3 4s 4p	((<3>2P)3P)4D
	101987.0	102103.0	-116.0	43% 3d3 4s 4p	((<3>2D)3D)4F	+ 11% 3d3 4s 4p	((<3>2P)1P)2D
	102602.0	102238.0	364.0	92% 3d3 4s 4p	((<3>2P)3P)4S		
	102684.0	102630.0	54.0	40% 3d3 4s 4p	((<3>4P)3P)4D	+ 21% 3d3 4s 4p	((<3>4P)5P)4D
	-	103046.0	-	26% 3d3 4s 4p	((<3>2P)1P)2D	+ 16% 3d3 4s 4p	((<3>2D)3D)4F
	-	104069.0	-	19% 3d3 4s 4p	((<3>2P)1P)2P	+ 17% 3d3 4s 4p	((<3>2D)1D)2P
	104275.0	104353.0	-78.0	41% 3d3 4s 4p	((<3>2D)3D)4D	+ 8% 3d3 4s 4p	((<1>2D)3D)4D
	-	104559.0	-	17% 3d4 4f	(<4>5D)4F	+ 13% 3d4 4f	(<4>3G)4F
	-	104662.0	-	16% 3d4 4f	(<4>5D)6G	+ 10% 3d4 4f	(<4>5D)4D
	-	104711.0	-	12% 3d4 4f	(<4>3H)4D	+ 11% 3d4 4f	(<4>5D)6G
	-	104748.0	-	14% 3d4 4f	(<4>3D)4P	+ 7% 3d4 4f	(<4>5D)6D
	-	104759.0	-	11% 3d4 4f	(<4>3H)4D	+ 11% 3d4 4f	(<4>3G)2D
	-	104773.0	-	10% 3d4 4f	(<4>5D)4P	+ 9% 3d4 4f	(<4>3D)2P
	-	104835.0	-	9% 3d4 4f	(<4>3D)2D	+ 9% 3d4 4f	(<4>5D)6F
	-	105064.0	-	19% 3d4 4f	(<4>3H)4D	+ 10% 3d4 4f	(<4>3F)4S
	-	105115.0	-	21% 3d3 4s 4p	((<3>2D)3D)4P	+ 17% 3d3 4s 4p	((<3>2P)3P)4P
	-	105206.0	-	25% 3d4 4f	(<4>5D)6F	+ 9% 3d4 4f	(<4>5D)4F
	-	105248.0	-	24% 3d4 4f	(<4>5D)4P	+ 11% 3d4 4f	(<4>5D)6G
	-	105268.0	-	28% 3d4 4f	(<4>5D)6D	+ 8% 3d4 4f	(<4>1G)2P
	-	105279.0	-	19% 3d4 4f	(<4>5D)4D	+ 18% 3d4 4f	(<4>3H)4F
	-	105293.0	-	21% 3d4 4f	(<4>5D)4F	+ 14% 3d4 4f	(<4>3G)4F
	-	105309.0	-	33% 3d4 4f	(<4>3H)2D	+ 10% 3d4 4f	(<4>5D)6P
	105283.0	105329.0	-46.0	12% 3d4 4f	(<4>1G)2P	+ 9% 3d4 4f	(<4>3G)2P
	-	105343.0	-	10% 3d4 4f	(<4>1G)2D	+ 9% 3d4 4f	(<4>3D)2D
	-	105360.0	-	15% 3d4 4f	(<4>3F)2D	+ 11% 3d4 4f	(<4>3G)4D
	-	105370.0	-	16% 3d4 4f	(<4>3F)4F	+ 15% 3d4 4f	(<4>3D)4F
	-	105381.0	-	16% 3d4 4f	(<4>3F)4D	+ 8% 3d4 4f	(<4>3D)2P
	-	105413.0	-	13% 3d4 4f	(<4>3P)4D	+ 9% 3d4 4f	(<4>1G)2D
	-	105441.0	-	15% 3d4 4f	(<4>1G)2P	+ 8% 3d4 4f	(<4>3F)4P
	-	105447.0	-	18% 3d4 4f	(<2>3F)4S	+ 10% 3d4 4f	(<2>3F)2D
	-	105469.0	-	14% 3d4 4f	(<2>3F)4D	+ 10% 3d4 4f	(<2>3F)2D
	-	105493.0	-	23% 3d4 4f	(<2>3F)4P	+ 10% 3d4 4f	(<4>1D)2P
	-	105526.0	-	12% 3d4 4f	(<2>1G)2D	+ 11% 3d4 4f	(<4>3F)2P
	-	105571.0	-	40% 3d4 4f	(<2>1D)2P	+ 9% 3d4 4f	(<2>3P)2D
	-	105580.0	-	34% 3d4 4f	(<2>1D)2D	+ 9% 3d4 4f	(<2>3P)4D
	-	105843.0	-	13% 3d4 4f	(<4>5D)4P	+ 12% 3d4 4f	(<4>5D)4D
	-	105875.0	-	15% 3d4 4f	(<4>5D)6P	+ 9% 3d4 4f	(<4>3F)4S
	-	105878.0	-	14% 3d4 4f	(<4>5D)4P	+ 11% 3d4 4f	(<4>3G)4F
	-	105903.0	-	20% 3d4 4f	(<4>5D)6D	+ 7% 3d4 4f	(<4>3F)4D
	-	105929.0	-	13% 3d4 4f	(<4>3G)2P	+ 9% 3d4 4f	(<2>1G)2P
	-	105946.0	-	16% 3d4 4f	(<4>3D)2P	+ 9% 3d4 4f	(<4>3D)4F
	-	105953.0	-	19% 3d4 4f	(<4>3G)2P	+ 12% 3d4 4f	(<4>3G)4D

	-	105976.0	-	13% 3d4 4f (<4>1F)2P + 9% 3d4 4f (<4>3D)4P
	-	106007.0	-	10% 3d4 4f (<4>1F)2D + 8% 3d4 4f (<4>3D)2P
	-	106016.0	-	15% 3d4 4f (<4>3D)4D + 13% 3d4 4f (<4>1F)2P
	-	106050.0	-	13% 3d4 4f (<2>3F)2D + 11% 3d4 4f (<2>3F)4S
	-	106094.0	-	37% 3d4 4f (<2>1G)2D + 6% 3d4 4f (<2>3F)4D
	-	106098.0	-	14% 3d4 4f (<4>1F)2P + 13% 3d4 4f (<2>3F)4P
	-	106105.0	-	29% 3d4 4f (<2>3P)4F + 23% 3d4 4f (<4>3P)4F
	-	106129.0	-	18% 3d4 4f (<4>1D)2D + 14% 3d4 4f (<2>3F)4F
	-	106139.0	-	18% 3d4 4f (<2>3F)2P + 15% 3d4 4f (<4>1D)2P
	-	106141.0	-	13% 3d4 4f (<4>1D)2P + 11% 3d4 4f (<2>1G)2P
	-	106518.0	-	16% 3d4 4f (<2>3F)2P + 9% 3d4 4f (<4>1G)2D
	-	106561.0	-	16% 3d4 4f (<2>3F)4P + 8% 3d4 4f (<4>5D)6P
	-	106630.0	-	19% 3d4 4f (<2>1D)2P + 9% 3d4 4f (<4>3F)4P
	-	106637.0	-	23% 3d4 4f (<2>1D)2D + 15% 3d4 4f (<4>3D)4F
	106726.0	107352.0	-626.0	35% 3d3 4s 4p ((<3>4P)3P)4S + 17% 3d3 4s 4p ((<3>4P)5P)4S
	-	107374.0	-	22% 3d3 4s 4p ((<3>4F)5F)4D + 22% 3d3 4s 4p ((<3>4P)3P)4S
	107212.0	107468.0	-256.0	63% 3d3 4s 4p ((<3>4P)3P)2D + 7% 3d3 4s 4p ((<3>4F)5F)4D
	-	108491.0	-	50% 3d3 4s 4p ((<3>4F)5F)4F + 32% 3d3 4s 4p ((<3>4F)3F)4F
	-	109473.0	-	39% 3d3 4s 4p ((<3>2P)1P)2P + 12% 3d3 4s 4p ((<3>2D)1D)2P
	109915.0	109760.0	155.0	36% 3d3 4s 4p ((<3>2D)1D)2D + 25% 3d3 4s 4p ((<3>2P)1P)2D
	-	112650.0	-	65% 3d4 4p (<2>1D)2P + 16% 3d4 4p (<4>1D)2P
	-	113824.0	-	93% 3d3 4s 4p ((<3>2F)3F)4F
	-	116036.0	-	70% 3d4 4p (<2>1D)2D + 23% 3d4 4p (<4>1D)2D
	-	117061.0	-	86% 3d3 4s 4p ((<3>2F)3F)4D + 7% 3d3 4s 4p ((<1>2D)3D)4D
	118622.0	118523.0	99.0	53% 3d3 4s 4p ((<3>4P)5P)4P + 42% 3d3 4s 4p ((<3>4P)3P)4P
	-	119414.0	-	54% 3d3 4s 4p ((<3>2F)1F)2D + 23% 3d3 4s 4p ((<3>2F)3F)2D
	-	121550.0	-	55% 3d3 4s 4p ((<3>4P)5P)4D + 30% 3d3 4s 4p ((<3>4P)3P)4D
	-	123732.0	-	40% 3d3 4s 4p ((<3>2P)3P)2P + 18% 3d3 4s 4p ((<3>2D)3D)2P
	-	124541.0	-	58% 3d3 4s 4p ((<3>2P)3P)2D + 20% 3d3 4s 4p ((<3>2P)1P)2D
	-	126095.0	-	62% 3d3 4s 4p ((<3>4P)5P)4S + 31% 3d3 4s 4p ((<3>4P)3P)4S
	-	127604.0	-	43% 3d3 4s 4p ((<3>2D)3D)2D + 19% 3d3 4s 4p ((<3>2D)1D)2D
	-	128711.0	-	29% 3d3 4s 4p ((<3>2P)3P)2P + 28% 3d3 4s 4p ((<3>2D)3D)2P
	-	131438.0	-	76% 3d3 4s 4p ((<1>2D)3D)4D + 18% 3d3 4s 4p ((<3>2D)3D)4D
	-	133459.0	-	70% 3d4 4p (<0>1S)2P + 20% 3d4 4p (<4>1S)2P
	-	133809.0	-	73% 3d3 4s 4p ((<1>2D)3D)4F + 23% 3d3 4s 4p ((<3>2D)3D)4F
	-	134714.0	-	43% 3d3 4s 4p ((<1>2D)1D)2D + 17% 3d3 4s 4p ((<1>2D)3D)2D
	-	136234.0	-	75% 3d3 4s 4p ((<1>2D)3D)4P + 24% 3d3 4s 4p ((<3>2D)3D)4P
	-	140613.0	-	62% 3d3 4s 4p ((<3>2F)3F)2D + 20% 3d3 4s 4p ((<3>2F)1F)2D
	-	142199.0	-	60% 3d3 4s 4p ((<1>2D)1D)2P + 19% 3d3 4s 4p ((<3>2D)1D)2P
	-	154347.0	-	52% 3d3 4s 4p ((<1>2D)3D)2D + 21% 3d3 4s 4p ((<1>2D)1D)2D
	-	160181.0	-	59% 3d3 4s 4p ((<1>2D)3D)2P + 18% 3d3 4s 4p ((<3>2D)3D)2P
5/2	47040.0	47512.0	-472.0	100% 3d4 4p (<4>5D)6F
	48491.0	48296.0	195.0	99% 3d4 4p (<4>5D)6P
	49352.0	49661.0	-309.0	82% 3d4 4p (<4>5D)4P + 15% 3d4 4p (<4>5D)6D
	49706.0	50076.0	-370.0	84% 3d4 4p (<4>5D)6D + 15% 3d4 4p (<4>5D)4P
	51669.0	51874.0	-205.0	96% 3d4 4p (<4>5D)4F
	54626.0	54742.0	-116.0	96% 3d4 4p (<4>5D)4D
	64449.0	65033.0	-584.0	45% 3d4 4p (<4>3P)4D + 29% 3d4 4p (<2>3P)4D
	65157.0	65238.0	-81.0	51% 3d4 4p (<4>3H)4G + 20% 3d4 4p (<4>3G)4G
	66727.0	66227.0	500.0	48% 3d4 4p (<4>3F)4G + 37% 3d4 4p (<4>3H)4G
	67121.0	67189.0	-68.0	32% 3d4 4p (<4>3F)4F + 23% 3d4 4p (<4>3P)4P
	67344.0	67261.0	83.0	35% 3d4 4p (<4>3F)4F + 32% 3d4 4p (<4>3P)4P
	67387.0	67590.0	-203.0	45% 3d4 4p (<4>3F)2D + 15% 3d4 4p (<2>3F)2D
	67868.0	67930.0	-62.0	49% 3d4 4p (<4>3F)4D + 14% 3d4 4p (<2>3F)4D
	68583.0	68568.0	15.0	36% 3d4 4p (<4>3G)2F + 29% 3d4 4p (<4>3F)2F
	69478.0	68978.0	500.0	80% 3d4 4p (<4>3G)4F + 7% 3d4 4p (<4>3D)4F
	69954.0	69827.0	127.0	71% 3d4 4p (<4>3G)4G + 9% 3d4 4p (<4>3F)4G
	70317.0	69981.0	336.0	50% 3d4 4p (<4>3P)2D + 32% 3d4 4p (<2>3P)2D
	70584.0	70265.0	319.0	43% 3d4 4p (<4>3F)2F + 41% 3d4 4p (<4>3G)2F
	73436.0	74152.0	-716.0	91% 3d4 4p (<4>3D)4D
	74319.0	74393.0	-74.0	56% 3d4 4p (<4>1G)2F + 26% 3d4 4p (<2>1G)2F
	74436.0	74688.0	-252.0	93% 3d4 4p (<4>3D)4P
	74484.0	75012.0	-528.0	87% 3d4 4p (<4>3D)4F + 7% 3d4 4p (<4>3G)4F
	76988.0	77342.0	-354.0	77% 3d4 4p (<4>3D)2F + 7% 3d4 4p (<4>3G)2F
	77935.0	78082.0	-147.0	77% 3d4 4p (<4>3D)2D + 10% 3d4 4p (<4>1D)2D
	-	79398.0	-	100% 3d3 4s 4p ((<3>4F)5F)6G
	80420.0	79803.0	617.0	59% 3d4 4p (<4>1D)2D + 19% 3d4 4p (<2>1D)2D
	81233.0	80828.0	405.0	68% 3d4 4p (<4>1D)2F + 17% 3d4 4p (<2>1D)2F
	81816.0	81604.0	212.0	96% 3d3 4s 4p ((<3>4F)5F)6D
	81962.0	82067.0	-105.0	99% 3d3 4s 4p ((<3>4F)5F)6F
	84605.0	83968.0	637.0	87% 3d4 4p (<4>1F)2F
	85779.0	85840.0	-61.0	47% 3d3 4s 4p ((<3>4F)3F)4D + 42% 3d3 4s 4p ((<3>4F)5F)4D
	86567.0	86495.0	72.0	60% 3d3 4s 4p ((<3>4F)3F)4G + 34% 3d3 4s 4p ((<3>4F)5F)4G
	86507.0	86554.0	-47.0	78% 3d4 4p (<4>1F)2D + 7% 3d4 4p (<2>3P)2D
	87767.0	87999.0	-232.0	37% 3d3 4s 4p ((<3>4F)3F)4F + 31% 3d3 4s 4p ((<3>4F)5F)4F
	89165.0	89080.0	85.0	85% 3d3 4s 4p ((<3>4F)3F)2D + 7% 3d3 4s 4p ((<3>4P)3P)2D
	89453.0	90125.0	-672.0	54% 3d4 4p (<2>3P)4P + 27% 3d4 4p (<4>3P)4P
	90258.0	90401.0	-143.0	49% 3d4 4p (<2>3F)4F + 20% 3d3 4s 4p ((<3>4F)3F)4F
	90442.0	90656.0	-214.0	24% 3d4 4p (<2>3F)4D + 23% 3d4 4p (<2>3P)4D
	90707.0	90772.0	-65.0	45% 3d4 4p (<2>3F)2F + 27% 3d3 4s 4p ((<3>4F)3F)2F
	91079.0	91407.0	-328.0	32% 3d4 4p (<2>3P)2D + 20% 3d4 4p (<4>3P)2D
	91426.0	91534.0	-108.0	72% 3d4 4p (<2>3F)4G + 23% 3d4 4p (<4>3F)4G
	92418.0	93110.0	-692.0	100% 3d3 4s 4p ((<3>4P)5P)6P
	93891.0	93608.0	283.0	65% 3d3 4s 4p ((<3>4F)3F)2F + 21% 3d4 4p (<2>3F)2F
	93671.0	94206.0	-535.0	37% 3d4 4p (<2>3F)4D + 26% 3d4 4p (<2>3P)4D

94266.0	94755.0	-489.0	96% 3d3 4s 4p ((<3>4P)5P)6D
97071.0	96377.0	694.0	88% 3d3 4s 4p ((<3>2G)3G)4G + 7% 3d3 4s 4p ((<3>4F)3F)4G
97183.0	97815.0	-632.0	40% 3d3 4s 4p ((<3>4P)3P)4P + 34% 3d3 4s 4p ((<3>4P)5P)4P
-	97986.0	-	27% 3d4 4p (<2>1G)2F + 22% 3d4 4p (<2>3F)2D
97875.0	98163.0	-288.0	62% 3d3 4s 4p ((<3>2G)3G)4F + 10% 3d4 4p (<2>3F)2D
98207.0	98279.0	-72.0	23% 3d4 4p (<2>1G)2F + 18% 3d3 4s 4p ((<3>2G)3G)4F
98642.0	98831.0	-189.0	93% 3d3 4s 4p ((<3>4P)5P)6S
-	100442.0	-	59% 3d3 4s 4p ((<3>2P)3P)4P + 24% 3d3 4s 4p ((<3>2D)3D)4P
101075.0	100931.0	144.0	70% 3d3 4s 4p ((<3>2P)3P)4D + 8% 3d3 4s 4p ((<3>4F)3F)4D
102146.0	101754.0	392.0	55% 3d3 4s 4p ((<3>2G)1G)2F + 24% 3d3 4s 4p ((<3>2G)3G)2F
102297.0	102397.0	-100.0	46% 3d3 4s 4p ((<3>2D)3D)4F + 12% 3d3 4s 4p ((<1>2D)3D)4F
102656.0	102612.0	44.0	39% 3d3 4s 4p ((<3>4P)3P)4D + 21% 3d3 4s 4p ((<3>4P)5P)4D
-	103109.0	-	27% 3d3 4s 4p ((<3>2P)1P)2D + 13% 3d3 4s 4p ((<3>2P)3P)2D
-	103859.0	-	17% 3d4 4f (<4>5D)4G + 13% 3d3 4s 4p ((<3>4F)5F)4G
-	104203.0	-	9% 3d3 4s 4p ((<3>2H)3H)4G + 7% 3d4 4f (<2>3P)4G
104468.0	104471.0	-3.0	53% 3d3 4s 4p ((<3>2D)3D)4D + 10% 3d3 4s 4p ((<1>2D)3D)4D
-	104609.0	-	12% 3d4 4f (<4>5D)6H + 10% 3d4 4f (<4>5D)4F
-	104649.0	-	11% 3d4 4f (<4>5D)6H + 9% 3d4 4f (<4>5D)6D
-	104721.0	-	9% 3d4 4f (<4>5D)6F + 6% 3d4 4f (<4>5D)4D
-	104739.0	-	10% 3d4 4f (<2>3F)4F + 9% 3d4 4f (<4>3G)2F
-	104754.0	-	8% 3d4 4f (<4>5D)4F + 7% 3d4 4f (<2>3F)2F
-	104760.0	-	13% 3d4 4f (<2>1G)2D + 7% 3d4 4f (<4>3H)4F
-	104773.0	-	11% 3d4 4f (<2>3F)4P + 8% 3d4 4f (<4>1F)2D
-	104838.0	-	32% 3d3 4s 4p ((<3>2H)3H)4G + 7% 3d4 4f (<2>1G)2F
-	105040.0	-	28% 3d4 4f (<4>3H)4D + 13% 3d3 4s 4p ((<3>2D)3D)4P
-	105095.0	-	10% 3d4 4f (<4>5D)4G + 9% 3d3 4s 4p ((<3>2D)3D)4P
-	105122.0	-	14% 3d4 4f (<4>3H)4F + 13% 3d4 4f (<4>3G)4F
-	105181.0	-	12% 3d4 4f (<4>5D)6D + 7% 3d4 4f (<4>3P)2D
-	105234.0	-	22% 3d4 4f (<4>5D)6H + 18% 3d4 4f (<4>5D)4P
-	105250.0	-	29% 3d4 4f (<4>5D)6G + 8% 3d4 4f (<4>1D)2F
-	105277.0	-	17% 3d4 4f (<4>5D)4D + 8% 3d4 4f (<4>5D)6F
-	105286.0	-	28% 3d4 4f (<4>5D)6P + 22% 3d4 4f (<4>3H)2F
-	105303.0	-	11% 3d4 4f (<4>3H)2F + 10% 3d4 4f (<4>5D)6F
-	105310.0	-	10% 3d4 4f (<4>3D)4F + 9% 3d4 4f (<4>3P)4G
-	105335.0	-	21% 3d4 4f (<4>3H)4G + 17% 3d4 4f (<4>3G)4G
-	105349.0	-	16% 3d4 4f (<4>1G)2F + 13% 3d4 4f (<4>3G)2D
-	105364.0	-	10% 3d4 4f (<4>1G)2F + 10% 3d4 4f (<4>3G)2D
-	105369.0	-	11% 3d4 4f (<4>1I)2F + 10% 3d4 4f (<4>3F)2F
-	105385.0	-	24% 3d4 4f (<4>1G)2D + 12% 3d4 4f (<4>3G)4P
-	105395.0	-	20% 3d4 4f (<4>3F)4G + 13% 3d4 4f (<4>3D)4G
-	105407.0	-	14% 3d4 4f (<4>3F)4P + 12% 3d4 4f (<4>3D)4P
-	105417.0	-	11% 3d4 4f (<4>3F)4F + 11% 3d4 4f (<4>1I)2F
-	105429.0	-	11% 3d4 4f (<2>3F)4G + 8% 3d4 4f (<2>3F)4F
105578.0	105454.0	124.0	9% 3d4 4f (<4>3H)2D + 8% 3d4 4f (<2>3F)4F
-	105462.0	-	24% 3d4 4f (<2>3F)2D + 7% 3d4 4f (<4>1G)2F
-	105498.0	-	24% 3d4 4f (<2>3F)2F + 13% 3d4 4f (<2>3F)4D
-	105518.0	-	14% 3d4 4f (<2>3F)4D + 13% 3d4 4f (<2>3F)4P
-	105565.0	-	40% 3d4 4f (<2>1D)2F + 6% 3d4 4f (<2>3F)4F
105595.0	105596.0	-1.0	40% 3d4 4f (<2>1D)2D + 8% 3d4 4f (<4>3P)4D
-	105660.0	-	44% 3d4 4f (<0>1S)2F + 12% 3d4 4f (<4>3P)4G
-	105792.0	-	10% 3d4 4f (<4>3G)4P + 9% 3d4 4f (<4>3H)4F
-	105830.0	-	9% 3d4 4f (<4>3D)2F + 9% 3d4 4f (<4>3D)4P
-	105869.0	-	11% 3d4 4f (<4>5D)6F + 8% 3d4 4f (<4>5D)6P
-	105890.0	-	12% 3d4 4f (<4>5D)6P + 8% 3d4 4f (<4>5D)6F
-	105901.0	-	15% 3d4 4f (<4>3D)2D + 11% 3d4 4f (<4>3D)4G
-	105912.0	-	13% 3d4 4f (<4>5D)4D + 9% 3d4 4f (<4>3G)4G
-	105919.0	-	9% 3d4 4f (<4>3D)4G + 8% 3d4 4f (<4>5D)4F
105122.0	105927.0	-805.0	16% 3d4 4f (<4>3G)2D + 13% 3d4 4f (<4>3H)2F
-	105978.0	-	13% 3d4 4f (<4>3G)4P + 10% 3d4 4f (<4>3F)4G
-	105983.0	-	10% 3d4 4f (<4>3G)4P + 10% 3d4 4f (<4>3G)4F
-	105993.0	-	11% 3d4 4f (<4>3F)2F + 9% 3d4 4f (<4>1F)2D
-	106013.0	-	15% 3d4 4f (<4>1S)2F + 12% 3d4 4f (<4>1I)2F
-	106026.0	-	23% 3d4 4f (<4>3D)4D + 9% 3d4 4f (<4>1F)2F
-	106028.0	-	11% 3d4 4f (<4>1S)2F + 7% 3d4 4f (<4>3P)2D
-	106051.0	-	12% 3d4 4f (<4>1F)2F + 9% 3d4 4f (<2>3F)4G
-	106076.0	-	20% 3d4 4f (<2>3P)2D + 9% 3d4 4f (<4>1D)2F
-	106092.0	-	27% 3d4 4f (<2>1G)2D + 7% 3d4 4f (<2>3F)4P
-	106106.0	-	15% 3d4 4f (<4>1F)2F + 12% 3d4 4f (<4>1D)2F
-	106111.0	-	24% 3d4 4f (<2>3P)4F + 11% 3d4 4f (<4>3P)4D
-	106116.0	-	17% 3d4 4f (<4>1D)2D + 14% 3d4 4f (<2>3F)4P
-	106136.0	-	12% 3d4 4f (<4>1D)2D + 10% 3d4 4f (<2>1G)2D
-	106158.0	-	13% 3d4 4f (<2>1G)2F + 12% 3d4 4f (<2>3F)2F
-	106509.0	-	12% 3d4 4f (<2>3F)2D + 8% 3d4 4f (<2>3F)4F
-	106551.0	-	15% 3d4 4f (<2>3F)4P + 14% 3d4 4f (<2>3F)4D
-	106568.0	-	10% 3d4 4f (<2>1D)2F + 10% 3d4 4f (<2>1D)2D
-	106617.0	-	13% 3d4 4f (<2>1D)2F + 10% 3d4 4f (<2>1D)2D
-	106753.0	-	37% 3d4 4f (<0>1S)2F + 21% 3d4 4f (<2>3P)4G
106719.0	106872.0	-153.0	34% 3d3 4s 4p ((<3>4F)5F)4G + 18% 3d3 4s 4p ((<3>4F)3F)4G
107022.0	107071.0	-49.0	36% 3d3 4s 4p ((<3>2D)1D)2F + 11% 3d3 4s 4p ((<1>2D)1D)2F
107356.0	107545.0	-189.0	62% 3d3 4s 4p ((<3>4P)3P)2D + 6% 3d3 4s 4p ((<3>4F)5F)4D
-	107670.0	-	33% 3d3 4s 4p ((<3>4F)5F)4D + 27% 3d3 4s 4p ((<3>4F)3F)4D
-	108709.0	-	49% 3d3 4s 4p ((<3>4F)5F)4F + 31% 3d3 4s 4p ((<3>4F)3F)4F
109944.0	109739.0	205.0	39% 3d3 4s 4p ((<3>2D)1D)2D + 28% 3d3 4s 4p ((<3>2P)1P)2D
-	113836.0	-	90% 3d3 4s 4p ((<3>2F)3F)4F
-	113879.0	-	67% 3d4 4p (<2>1D)2F + 19% 3d4 4p (<4>1D)2F
-	115845.0	-	94% 3d3 4s 4p ((<3>2F)3F)4G + 5% 3d3 4s 4p ((<3>2H)3H)4G

	-	116134.0	-	70% 3d4 4p (<2>1D)2D	+ 22% 3d4 4p (<4>1D)2D
	-	116929.0	-	86% 3d3 4s 4p ((<3>2F)3F)4D	+ 8% 3d3 4s 4p ((<1>2D)3D)4D
	118640.0	118648.0	-8.0	52% 3d3 4s 4p ((<3>4P)5P)4P	+ 43% 3d3 4s 4p ((<3>4P)3P)4P
	-	119337.0	-	51% 3d3 4s 4p ((<3>2F)1F)2D	+ 21% 3d3 4s 4p ((<3>2F)3F)2D
	-	119974.0	-	67% 3d3 4s 4p ((<3>2F)1F)2F	+ 17% 3d3 4s 4p ((<3>2F)3F)2F
	-	121649.0	-	55% 3d3 4s 4p ((<3>4P)5P)4D	+ 30% 3d3 4s 4p ((<3>4P)3P)4D
	-	122000.0	-	63% 3d3 4s 4p ((<3>2G)3G)2F	+ 22% 3d3 4s 4p ((<3>2G)1G)2F
	-	124343.0	-	50% 3d3 4s 4p ((<3>2P)3P)2D	+ 19% 3d3 4s 4p ((<3>2P)1P)2D
	-	125846.0	-	49% 3d3 4s 4p ((<3>2D)3D)2F	+ 14% 3d3 4s 4p ((<3>2D)1D)2F
	-	128189.0	-	46% 3d3 4s 4p ((<3>2D)3D)2D	+ 20% 3d3 4s 4p ((<3>2D)1D)2D
	-	131457.0	-	76% 3d3 4s 4p ((<1>2D)3D)4D	+ 17% 3d3 4s 4p ((<3>2D)3D)4D
	-	133843.0	-	74% 3d3 4s 4p ((<1>2D)3D)4F	+ 23% 3d3 4s 4p ((<3>2D)3D)4F
	-	134710.0	-	42% 3d3 4s 4p ((<1>2D)1D)2D	+ 18% 3d3 4s 4p ((<1>2D)3D)2D
	-	136011.0	-	75% 3d3 4s 4p ((<1>2D)3D)4P	+ 23% 3d3 4s 4p ((<3>2D)3D)4P
	-	137362.0	-	37% 3d3 4s 4p ((<1>2D)1D)2F	+ 35% 3d3 4s 4p ((<3>2F)3F)2F
	-	138658.0	-	39% 3d3 4s 4p ((<3>2F)3F)2F	+ 20% 3d3 4s 4p ((<1>2D)1D)2F
	-	140441.0	-	62% 3d3 4s 4p ((<3>2F)3F)2D	+ 18% 3d3 4s 4p ((<3>2F)1F)2D
	-	154324.0	-	52% 3d3 4s 4p ((<1>2D)3D)2D	+ 22% 3d3 4s 4p ((<1>2D)1D)2D
	-	156760.0	-	56% 3d3 4s 4p ((<1>2D)3D)2F	+ 19% 3d3 4s 4p ((<1>2D)1D)2F
7/2	47227.0	47684.0	-457.0	100% 3d4 4p (<4>5D)6F	
	48632.0	48472.0	160.0	100% 3d4 4p (<4>5D)6P	
	49666.0	50177.0	-511.0	99% 3d4 4p (<4>5D)6D	
	51789.0	52010.0	-221.0	96% 3d4 4p (<4>5D)4F	
	54784.0	54921.0	-137.0	96% 3d4 4p (<4>5D)4D	
	63601.0	62858.0	743.0	87% 3d4 4p (<4>3H)4H	+ 12% 3d4 4p (<4>3G)4H
	64925.0	64842.0	83.0	65% 3d4 4p (<4>3H)2G	+ 17% 3d4 4p (<4>3F)2G
	65257.0	65330.0	-73.0	53% 3d4 4p (<4>3H)4G	+ 19% 3d4 4p (<4>3G)4G
	65543.0	65439.0	104.0	40% 3d4 4p (<4>3P)4D	+ 26% 3d4 4p (<2>3P)4D
	67334.0	66313.0	1021.0	51% 3d4 4p (<4>3F)4G	+ 31% 3d4 4p (<4>3H)4G
	67394.0	67324.0	70.0	77% 3d4 4p (<4>3F)4F	+ 15% 3d4 4p (<2>3F)4F
	67875.0	67989.0	-114.0	44% 3d4 4p (<4>3F)4D	+ 19% 3d4 4p (<4>3P)4D
	68760.0	68633.0	127.0	86% 3d4 4p (<4>3G)4H	+ 11% 3d4 4p (<4>3H)4H
	68843.0	68757.0	86.0	32% 3d4 4p (<4>3F)2F	+ 31% 3d4 4p (<4>3G)2F
	69506.0	69018.0	488.0	79% 3d4 4p (<4>3G)4F	+ 6% 3d4 4p (<4>3D)4F
	69904.0	69659.0	245.0	46% 3d4 4p (<4>3F)2G	+ 17% 3d4 4p (<2>3F)2G
	70427.0	69947.0	480.0	67% 3d4 4p (<4>3G)4G	+ 8% 3d4 4p (<4>3F)4G
	70852.0	70507.0	345.0	49% 3d4 4p (<4>3G)2F	+ 38% 3d4 4p (<4>3F)2F
	72649.0	72162.0	487.0	84% 3d4 4p (<4>3G)2G	+ 8% 3d4 4p (<4>3H)2G
	73486.0	74134.0	-648.0	44% 3d4 4p (<4>1G)2F	+ 21% 3d4 4p (<4>3D)4D
	74114.0	74208.0	-94.0	72% 3d4 4p (<4>3D)4D	+ 14% 3d4 4p (<4>1G)2F
	74424.0	75067.0	-643.0	88% 3d4 4p (<4>3D)4F	+ 7% 3d4 4p (<4>3G)4F
	75717.0	75711.0	6.0	54% 3d4 4p (<4>1G)2G	+ 31% 3d4 4p (<2>1G)2G
	76879.0	77275.0	-396.0	79% 3d4 4p (<4>3D)2F	+ 7% 3d4 4p (<4>3G)2F
	-	79604.0	-	100% 3d3 4s 4p ((<3>4F)5F)6G	
	81432.0	80948.0	484.0	69% 3d4 4p (<4>1D)2F	+ 17% 3d4 4p (<2>1D)2F
	81978.0	81789.0	189.0	96% 3d3 4s 4p ((<3>4F)5F)6D	
	82143.0	82267.0	-124.0	99% 3d3 4s 4p ((<3>4F)5F)6F	
	84677.0	84027.0	650.0	86% 3d4 4p (<4>1F)2F	+ 5% 3d4 4p (<4>1D)2F
	85573.0	85452.0	121.0	94% 3d4 4p (<4>1F)2G	
	86079.0	86157.0	-78.0	48% 3d3 4s 4p ((<3>4F)3F)4D	+ 42% 3d3 4s 4p ((<3>4F)5F)4D
	86797.0	86722.0	75.0	60% 3d3 4s 4p ((<3>4F)3F)4G	+ 35% 3d3 4s 4p ((<3>4F)5F)4G
	87917.0	88169.0	-252.0	34% 3d3 4s 4p ((<3>4F)3F)4F	+ 31% 3d3 4s 4p ((<3>4F)5F)4F
	90218.0	90414.0	-196.0	27% 3d4 4p (<2>3F)4F	+ 16% 3d4 4p (<2>3F)4D
	90490.0	90610.0	-120.0	27% 3d4 4p (<2>3F)4F	+ 18% 3d4 4p (<2>3P)4D
	90831.0	90877.0	-46.0	50% 3d4 4p (<2>3F)2F	+ 23% 3d3 4s 4p ((<3>4F)3F)2F
	91752.0	91159.0	593.0	92% 3d3 4s 4p ((<3>4F)3F)2G	
	91123.0	91585.0	-462.0	73% 3d4 4p (<2>3F)4G	+ 23% 3d4 4p (<4>3F)4G
	92653.0	93319.0	-666.0	100% 3d3 4s 4p ((<3>4P)5P)6P	
	94219.0	93897.0	322.0	61% 3d3 4s 4p ((<3>4F)3F)2F	+ 13% 3d4 4p (<2>3F)2F
	93532.0	94073.0	-541.0	33% 3d4 4p (<2>3F)4D	+ 22% 3d4 4p (<2>3P)4D
	93801.0	94152.0	-351.0	74% 3d4 4p (<2>3F)2G	+ 20% 3d4 4p (<4>3F)2G
	94453.0	94972.0	-519.0	96% 3d3 4s 4p ((<3>4P)5P)6D	
	-	95341.0	-	76% 3d3 4s 4p ((<3>2G)3G)4H	+ 22% 3d3 4s 4p ((<3>2H)3H)4H
	97187.0	96482.0	705.0	85% 3d3 4s 4p ((<3>2G)3G)4G	+ 6% 3d3 4s 4p ((<3>4F)3F)4G
	97728.0	96771.0	957.0	54% 3d4 4p (<2>1G)2G	+ 28% 3d4 4p (<4>1G)2G
	99069.0	97969.0	1100.0	47% 3d4 4p (<2>1G)2F	+ 21% 3d4 4p (<4>1G)2F
	98719.0	98257.0	462.0	79% 3d3 4s 4p ((<3>2G)3G)4F	+ 6% 3d3 4s 4p ((<3>2D)3D)4F
	-	99681.0	-	69% 3d3 4s 4p ((<3>2H)3H)4H	+ 20% 3d3 4s 4p ((<3>2G)3G)4H
	101170.0	100962.0	208.0	52% 3d3 4s 4p ((<3>2G)1G)2G	+ 19% 3d3 4s 4p ((<3>2G)3G)2G
	101514.0	101272.0	242.0	74% 3d3 4s 4p ((<3>2P)3P)4D	+ 7% 3d3 4s 4p ((<3>4F)3F)4D
	101864.0	101578.0	286.0	52% 3d3 4s 4p ((<3>2G)1G)2F	+ 21% 3d3 4s 4p ((<3>2G)3G)2F
	102493.0	102680.0	-187.0	33% 3d3 4s 4p ((<3>2D)3D)4F	+ 24% 3d3 4s 4p ((<3>4P)3P)4D
	102832.0	102771.0	61.0	28% 3d3 4s 4p ((<3>2D)3D)4F	+ 24% 3d3 4s 4p ((<3>4P)3P)4D
	-	104090.0	-	13% 3d4 4f (<4>5D)4G	+ 9% 3d4 4f (<2>3P)2G
	102915.0	104120.0	-1205.0	15% 3d3 4s 4p ((<3>2H)3H)4G	+ 12% 3d3 4s 4p ((<3>4F)5F)4G
	-	104627.0	-	12% 3d4 4f (<4>5D)4H	+ 11% 3d3 4s 4p ((<3>2D)3D)4D
	104681.0	104644.0	37.0	8% 3d4 4f (<4>5D)4H	+ 7% 3d4 4f (<4>5D)6F
	-	104704.0	-	15% 3d3 4s 4p ((<3>2D)3D)4D	+ 10% 3d4 4f (<4>5D)6P
	-	104720.0	-	13% 3d4 4f (<2>1G)2G	+ 10% 3d4 4f (<4>3H)4H
	-	104741.0	-	16% 3d4 4f (<4>5D)6H	+ 9% 3d4 4f (<4>1D)2G
	-	104743.0	-	10% 3d4 4f (<4>3D)2F	+ 9% 3d4 4f (<2>3F)2G
	-	104767.0	-	9% 3d4 4f (<2>3F)4G	+ 8% 3d4 4f (<4>3D)4F
	-	104811.0	-	11% 3d3 4s 4p ((<3>2H)3H)4G	+ 9% 3d4 4f (<2>3F)2F
	-	104817.0	-	23% 3d3 4s 4p ((<3>2D)3D)4D	+ 8% 3d4 4f (<2>3F)4D
	-	105091.0	-	19% 3d3 4s 4p ((<3>2H)3H)4G	+ 14% 3d4 4f (<4>5D)4G

	-	105157.0	-	14% 3d4 4f (<4>3G)4F	+ 10% 3d4 4f (<4>3H)4F
	-	105215.0	-	21% 3d4 4f (<4>3H)4D	+ 13% 3d4 4f (<4>1I)2F
	-	105238.0	-	27% 3d4 4f (<4>5D)4H	+ 15% 3d4 4f (<4>5D)6D
	105197.0	105253.0	-56.0	19% 3d4 4f (<4>5D)6H	+ 8% 3d4 4f (<4>3H)4D
	-	105266.0	-	20% 3d4 4f (<4>3H)2G	+ 10% 3d4 4f (<4>5D)6G
	-	105274.0	-	18% 3d4 4f (<4>5D)6F	+ 12% 3d4 4f (<4>5D)4D
	-	105290.0	-	12% 3d4 4f (<4>5D)6G	+ 11% 3d4 4f (<4>3G)2G
	-	105303.0	-	21% 3d4 4f (<4>3H)4H	+ 19% 3d4 4f (<4>3H)4F
	-	105328.0	-	16% 3d4 4f (<4>3H)2F	+ 14% 3d4 4f (<4>3H)4G
	-	105343.0	-	20% 3d4 4f (<4>3D)4H	+ 8% 3d4 4f (<4>3P)4G
	-	105346.0	-	18% 3d4 4f (<4>1G)2G	+ 12% 3d4 4f (<4>3G)4G
	-	105353.0	-	11% 3d4 4f (<4>3P)4D	+ 10% 3d4 4f (<4>3D)4F
	-	105362.0	-	13% 3d4 4f (<4>3G)4D	+ 8% 3d4 4f (<4>3F)4F
	-	105373.0	-	20% 3d4 4f (<4>3G)4H	+ 14% 3d4 4f (<4>3D)2F
	-	105377.0	-	13% 3d4 4f (<4>3H)4G	+ 13% 3d4 4f (<4>1I)2G
	-	105385.0	-	20% 3d4 4f (<4>3F)4H	+ 11% 3d4 4f (<4>3D)4G
	-	105397.0	-	10% 3d4 4f (<4>3G)2G	+ 7% 3d4 4f (<4>3D)2G
	-	105449.0	-	12% 3d4 4f (<4>3P)4D	+ 10% 3d4 4f (<4>1G)2F
	105508.0	105464.0	44.0	11% 3d4 4f (<2>3F)4F	+ 11% 3d4 4f (<4>1D)2F
	-	105471.0	-	25% 3d4 4f (<2>3F)4H	+ 16% 3d4 4f (<2>3F)2G
	-	105502.0	-	15% 3d4 4f (<2>3F)4F	+ 12% 3d4 4f (<2>3F)4D
	-	105524.0	-	16% 3d4 4f (<2>3F)2F	+ 15% 3d4 4f (<4>3F)2F
	-	105587.0	-	26% 3d4 4f (<2>1D)2G	+ 18% 3d4 4f (<2>1D)2F
	-	105593.0	-	26% 3d4 4f (<2>1D)2F	+ 16% 3d4 4f (<2>1D)2G
	105725.0	105665.0	60.0	41% 3d4 4f (<0>1S)2F	+ 7% 3d4 4f (<4>3P)4D
	-	105772.0	-	11% 3d4 4f (<4>5D)6F	+ 7% 3d4 4f (<4>3F)2G
	-	105803.0	-	25% 3d4 4f (<4>1I)2F	+ 9% 3d4 4f (<4>3G)4D
	-	105834.0	-	12% 3d4 4f (<4>3H)2G	+ 11% 3d4 4f (<4>3G)2F
	-	105873.0	-	10% 3d4 4f (<4>3H)4G	+ 9% 3d4 4f (<4>5D)6P
	-	105893.0	-	13% 3d4 4f (<4>5D)4D	+ 10% 3d4 4f (<4>3F)4G
	-	105903.0	-	11% 3d4 4f (<4>3H)4H	+ 11% 3d4 4f (<4>5D)6F
	-	105913.0	-	18% 3d4 4f (<4>3D)4H	+ 13% 3d4 4f (<4>3D)4G
	-	105925.0	-	14% 3d4 4f (<4>3D)2G	+ 11% 3d4 4f (<4>3D)4F
	105986.0	105932.0	54.0	23% 3d4 4f (<4>3G)2F	+ 13% 3d4 4f (<4>3H)2F
	-	105942.0	-	17% 3d4 4f (<4>3G)4D	+ 17% 3d4 4f (<4>3H)4F
	-	105956.0	-	9% 3d4 4f (<4>3F)4H	+ 7% 3d4 4f (<4>3D)4H
	-	105994.0	-	16% 3d4 4f (<4>3P)4F	+ 13% 3d4 4f (<4>3F)4H
	-	106006.0	-	24% 3d4 4f (<4>1S)2F	+ 7% 3d4 4f (<4>3P)4D
	-	106011.0	-	17% 3d4 4f (<4>1S)2F	+ 9% 3d4 4f (<4>3D)2F
	-	106032.0	-	15% 3d4 4f (<4>1F)2F	+ 12% 3d4 4f (<4>3D)4D
	-	106072.0	-	15% 3d4 4f (<2>1G)2F	+ 13% 3d4 4f (<2>3F)4D
	-	106087.0	-	19% 3d4 4f (<2>3P)2F	+ 14% 3d4 4f (<4>1D)2G
	-	106100.0	-	15% 3d4 4f (<2>3P)4G	+ 9% 3d4 4f (<2>3P)2G
	-	106109.0	-	13% 3d4 4f (<2>1G)2F	+ 11% 3d4 4f (<4>1F)2G
	-	106112.0	-	44% 3d4 4f (<2>1G)2G	+ 6% 3d4 4f (<4>1G)2G
	-	106117.0	-	15% 3d4 4f (<2>1G)2F	+ 13% 3d4 4f (<4>1F)2F
	-	106121.0	-	15% 3d4 4f (<4>1D)2G	+ 12% 3d4 4f (<4>1F)2G
	-	106144.0	-	16% 3d4 4f (<2>3P)4D	+ 9% 3d4 4f (<4>1D)2F
	-	106507.0	-	15% 3d4 4f (<2>3F)4D	+ 11% 3d4 4f (<4>1G)2F
	-	106540.0	-	13% 3d4 4f (<2>3F)2F	+ 10% 3d4 4f (<4>1G)2G
	-	106591.0	-	12% 3d3 4s 4p ((<3>2H)1H)2G	+ 8% 3d4 4f (<2>1D)2G
	-	106624.0	-	19% 3d4 4f (<2>1D)2F	+ 9% 3d4 4f (<4>3D)4D
	-	106645.0	-	20% 3d3 4s 4p ((<3>2H)1H)2G	+ 13% 3d4 4f (<2>1D)2G
	-	106762.0	-	35% 3d4 4f (<0>1S)2F	+ 12% 3d4 4f (<2>3P)2G
	-	107073.0	-	37% 3d3 4s 4p ((<3>4F)5F)4G	+ 20% 3d3 4s 4p ((<3>4F)3F)4G
	107153.0	107167.0	-14.0	44% 3d3 4s 4p ((<3>2D)1D)2F	+ 14% 3d3 4s 4p ((<3>2D)3D)2F
	107918.0	108028.0	-110.0	40% 3d3 4s 4p ((<3>4F)5F)4D	+ 32% 3d3 4s 4p ((<3>4F)3F)4D
	-	108996.0	-	49% 3d3 4s 4p ((<3>4F)5F)4F	+ 32% 3d3 4s 4p ((<3>4F)3F)4F
	-	113862.0	-	92% 3d3 4s 4p ((<3>2F)3F)4F	
	-	114118.0	-	70% 3d4 4p (<2>1D)2F	+ 20% 3d4 4p (<4>1D)2F
	-	115898.0	-	93% 3d3 4s 4p ((<3>2F)3F)4G	+ 5% 3d3 4s 4p ((<3>2H)3H)4G
	-	116744.0	-	86% 3d3 4s 4p ((<3>2F)3F)4D	+ 8% 3d3 4s 4p ((<1>2D)3D)4D
	-	119885.0	-	62% 3d3 4s 4p ((<3>2G)3G)2G	+ 24% 3d3 4s 4p ((<3>2G)1G)2G
	-	119913.0	-	36% 3d3 4s 4p ((<3>2F)1F)2G	+ 29% 3d3 4s 4p ((<3>2F)1F)2F
	-	120123.0	-	42% 3d3 4s 4p ((<3>2F)1F)2F	+ 24% 3d3 4s 4p ((<3>2F)1F)2G
	-	121835.0	-	55% 3d3 4s 4p ((<3>4P)5P)4D	+ 32% 3d3 4s 4p ((<3>4P)3P)4D
	-	122330.0	-	64% 3d3 4s 4p ((<3>2G)3G)2F	+ 22% 3d3 4s 4p ((<3>2G)1G)2F
	-	125980.0	-	56% 3d3 4s 4p ((<3>2D)3D)2F	+ 17% 3d3 4s 4p ((<3>2D)1D)2F
	-	127919.0	-	60% 3d3 4s 4p ((<3>2H)3H)2G	+ 25% 3d3 4s 4p ((<3>2H)1H)2G
	-	131504.0	-	77% 3d3 4s 4p ((<1>2D)3D)4D	+ 17% 3d3 4s 4p ((<3>2D)3D)4D
	-	133893.0	-	75% 3d3 4s 4p ((<1>2D)3D)4F	+ 23% 3d3 4s 4p ((<3>2D)3D)4F
	-	137508.0	-	45% 3d3 4s 4p ((<3>2F)3F)2F	+ 29% 3d3 4s 4p ((<1>2D)1D)2F
	-	138690.0	-	44% 3d3 4s 4p ((<3>2F)3F)2G	+ 15% 3d3 4s 4p ((<3>2F)1F)2G
	-	138817.0	-	23% 3d3 4s 4p ((<3>2F)3F)2G	+ 20% 3d3 4s 4p ((<3>2F)3F)2F
	-	156555.0	-	56% 3d3 4s 4p ((<1>2D)3D)2F	+ 20% 3d3 4s 4p ((<1>2D)1D)2F
9/2	47465.0	47902.0	-437.0	100% 3d4 4p (<4>5D)6F	
	49838.0	50378.0	-540.0	98% 3d4 4p (<4>5D)6D	
	51943.0	52186.0	-243.0	96% 3d4 4p (<4>5D)4F	
	63706.0	62964.0	742.0	87% 3d4 4p (<4>3H)4H	+ 11% 3d4 4p (<4>3G)4H
	65218.0	64398.0	820.0	98% 3d4 4p (<4>3H)4I	
	65384.0	64948.0	436.0	60% 3d4 4p (<4>3H)2G	+ 18% 3d4 4p (<4>3F)2G
	65670.0	65412.0	258.0	56% 3d4 4p (<4>3H)4G	+ 17% 3d4 4p (<4>3G)4G
	67353.0	66434.0	919.0	56% 3d4 4p (<4>3F)4G	+ 25% 3d4 4p (<4>3H)4G
	67449.0	67296.0	153.0	87% 3d4 4p (<4>3H)2H	+ 5% 3d4 4p (<4>1G)2H
	68477.0	67371.0	1106.0	76% 3d4 4p (<4>3F)4F	+ 14% 3d4 4p (<2>3F)4F

68992.0	68784.0	208.0	86% 3d4 4p (<4>3G)4H	+ 10% 3d4 4p (<4>3H)4H
69498.0	69023.0	475.0	82% 3d4 4p (<4>3G)4F	+ 6% 3d4 4p (<4>3D)4F
70108.0	69802.0	306.0	44% 3d4 4p (<4>3F)2G	+ 17% 3d4 4p (<4>3H)2G
70394.0	70000.0	394.0	61% 3d4 4p (<4>3G)4G	+ 11% 3d4 4p (<4>3G)2H
70679.0	70443.0	236.0	67% 3d4 4p (<4>3G)2H	+ 12% 3d4 4p (<4>1I)2H
72717.0	72299.0	418.0	83% 3d4 4p (<4>3G)2G	+ 9% 3d4 4p (<4>3H)2G
74456.0	74347.0	109.0	50% 3d4 4p (<4>1G)2H	+ 21% 3d4 4p (<2>1G)2H
74504.0	75131.0	-627.0	91% 3d4 4p (<4>3D)4F	+ 7% 3d4 4p (<4>3G)4F
-	75239.0	-	72% 3d4 4p (<4>1I)2H	+ 10% 3d4 4p (<2>1G)2H
75810.0	75759.0	51.0	53% 3d4 4p (<4>1G)2G	+ 31% 3d4 4p (<2>1G)2G
-	79866.0	-	100% 3d3 4s 4p ((<3>4F)5F)6G	
82193.0	82031.0	162.0	96% 3d3 4s 4p ((<3>4F)5F)6D	
82362.0	82518.0	-156.0	100% 3d3 4s 4p ((<3>4F)5F)6F	
85939.0	85749.0	190.0	95% 3d4 4p (<4>1F)2G	
87093.0	87014.0	79.0	59% 3d3 4s 4p ((<3>4F)3F)4G	+ 35% 3d3 4s 4p ((<3>4F)5F)4G
88073.0	88349.0	-276.0	31% 3d4 4p (<2>3F)4F	+ 31% 3d3 4s 4p ((<3>4F)3F)4F
90589.0	90631.0	-42.0	50% 3d4 4p (<2>3F)4F	+ 27% 3d3 4s 4p ((<3>4F)3F)4F
92144.0	91580.0	564.0	77% 3d3 4s 4p ((<3>4F)3F)2G	+ 13% 3d4 4p (<2>3F)4G
91190.0	91656.0	-466.0	60% 3d4 4p (<2>3F)4G	+ 18% 3d4 4p (<4>3F)4G
93641.0	94002.0	-361.0	75% 3d4 4p (<2>3F)2G	+ 19% 3d4 4p (<4>3F)2G
94656.0	95257.0	-601.0	97% 3d3 4s 4p ((<3>4P)5P)6D	
-	95518.0	-	74% 3d3 4s 4p ((<3>2G)3G)4H	+ 22% 3d3 4s 4p ((<3>2H)3H)4H
97333.0	96615.0	718.0	81% 3d3 4s 4p ((<3>2G)3G)4G	+ 6% 3d3 4s 4p ((<3>4F)3F)4G
97480.0	96727.0	753.0	39% 3d4 4p (<2>1G)2G	+ 20% 3d4 4p (<4>1G)2G
97904.0	97038.0	866.0	43% 3d4 4p (<2>1G)2H	+ 22% 3d4 4p (<4>1G)2H
98813.0	98313.0	500.0	86% 3d3 4s 4p ((<3>2G)3G)4F	+ 5% 3d3 4s 4p ((<3>2D)3D)4F
-	99835.0	-	72% 3d3 4s 4p ((<3>2H)3H)4H	+ 21% 3d3 4s 4p ((<3>2G)3G)4H
-	100758.0	-	31% 3d3 4s 4p ((<3>2G)1G)2G	+ 21% 3d3 4s 4p ((<3>2G)1G)2H
101297.0	100996.0	301.0	26% 3d3 4s 4p ((<3>2G)1G)2G	+ 22% 3d3 4s 4p ((<3>2G)1G)2H
101696.0	101762.0	-66.0	69% 3d3 4s 4p ((<3>2H)3H)4I	+ 18% 3d3 4s 4p ((<3>2G)1G)2H
103200.0	102913.0	287.0	66% 3d3 4s 4p ((<3>2D)3D)4F	+ 16% 3d3 4s 4p ((<1>2D)3D)4F
-	103757.0	-	64% 3d3 4s 4p ((<3>2H)1H)2H	+ 16% 3d3 4s 4p ((<3>2H)3H)2H
-	104302.0	-	30% 3d3 4s 4p ((<3>2H)3H)4G	+ 18% 3d4 4f (<4>5D)4G
-	104648.0	-	14% 3d4 4f (<4>5D)6G	+ 14% 3d4 4f (<2>3P)4G
-	104708.0	-	14% 3d4 4f (<2>1G)2G	+ 13% 3d4 4f (<4>3H)2H
-	104734.0	-	10% 3d4 4f (<2>1G)2H	+ 9% 3d4 4f (<4>3F)2G
-	104753.0	-	13% 3d4 4f (<4>1D)2G	+ 9% 3d4 4f (<4>5D)6F
-	104771.0	-	8% 3d4 4f (<2>3F)4I	+ 8% 3d4 4f (<4>1F)2H
-	104782.0	-	12% 3d4 4f (<4>1F)2G	+ 10% 3d4 4f (<2>3F)2H
-	104792.0	-	11% 3d3 4s 4p ((<3>2H)3H)4G	+ 8% 3d4 4f (<4>3G)4I
-	105085.0	-	21% 3d4 4f (<4>5D)4G	+ 18% 3d3 4s 4p ((<3>2H)3H)4G
-	105214.0	-	18% 3d4 4f (<4>5D)4F	+ 12% 3d4 4f (<4>3H)2G
105264.0	105250.0	14.0	15% 3d4 4f (<4>5D)6H	+ 11% 3d4 4f (<4>5D)4H
-	105252.0	-	22% 3d4 4f (<4>5D)6F	+ 16% 3d4 4f (<4>5D)4H
-	105266.0	-	27% 3d4 4f (<4>3H)2H	+ 10% 3d4 4f (<4>5D)6D
-	105283.0	-	18% 3d4 4f (<4>3G)2H	+ 15% 3d4 4f (<4>5D)6H
-	105286.0	-	13% 3d4 4f (<4>3G)4H	+ 12% 3d4 4f (<4>5D)6D
-	105311.0	-	18% 3d4 4f (<4>3G)4G	+ 17% 3d4 4f (<4>3H)4H
-	105323.0	-	17% 3d4 4f (<4>3H)4H	+ 11% 3d4 4f (<4>3D)2H
-	105344.0	-	26% 3d4 4f (<4>3G)4F	+ 18% 3d4 4f (<4>3H)4F
-	105358.0	-	15% 3d4 4f (<4>3D)2G	+ 13% 3d4 4f (<4>3P)4F
-	105366.0	-	22% 3d4 4f (<4>3F)4H	+ 13% 3d4 4f (<4>3D)4G
-	105373.0	-	20% 3d4 4f (<4>1G)2G	+ 14% 3d4 4f (<4>3G)4H
-	105382.0	-	18% 3d4 4f (<4>3G)4I	+ 10% 3d4 4f (<4>3H)4G
-	105391.0	-	15% 3d4 4f (<4>3F)4I	+ 13% 3d4 4f (<4>3P)2G
-	105393.0	-	12% 3d4 4f (<4>3F)4G	+ 12% 3d4 4f (<4>3F)4I
-	105405.0	-	11% 3d4 4f (<4>3H)4G	+ 10% 3d4 4f (<4>3P)4F
-	105472.0	-	40% 3d4 4f (<2>3F)4I	+ 17% 3d4 4f (<2>3P)2G
105398.0	105476.0	-78.0	20% 3d4 4f (<2>3F)2H	+ 16% 3d4 4f (<2>3F)4G
105407.0	105496.0	-89.0	12% 3d4 4f (<2>3F)4F	+ 11% 3d4 4f (<2>3F)4H
-	105503.0	-	20% 3d4 4f (<2>3F)2G	+ 13% 3d4 4f (<4>3F)2G
-	105585.0	-	38% 3d4 4f (<2>1D)2G	+ 8% 3d4 4f (<2>3P)4F
-	105609.0	-	39% 3d4 4f (<2>1D)2H	+ 10% 3d4 4f (<2>3F)4I
105609.0	105696.0	-87.0	9% 3d4 4f (<4>3H)4H	+ 7% 3d4 4f (<4>1G)2H
-	105785.0	-	13% 3d4 4f (<4>3H)4F	+ 12% 3d4 4f (<4>3G)4F
-	105866.0	-	16% 3d4 4f (<4>5D)6F	+ 15% 3d4 4f (<4>5D)6D
-	105888.0	-	17% 3d4 4f (<4>5D)6G	+ 13% 3d4 4f (<4>3F)4H
105790.0	105900.0	-110.0	15% 3d4 4f (<4>5D)4F	+ 13% 3d4 4f (<4>3H)4F
-	105913.0	-	17% 3d4 4f (<4>3D)2H	+ 11% 3d4 4f (<4>5D)4H
-	105922.0	-	22% 3d4 4f (<4>3G)4F	+ 22% 3d4 4f (<4>3H)4G
-	105950.0	-	18% 3d4 4f (<4>3G)2G	+ 16% 3d4 4f (<4>3H)4H
-	105961.0	-	25% 3d4 4f (<4>3H)2G	+ 19% 3d4 4f (<4>1I)2H
-	105988.0	-	15% 3d4 4f (<4>3P)4F	+ 13% 3d4 4f (<4>3F)4H
-	105998.0	-	20% 3d4 4f (<4>3F)4I	+ 10% 3d4 4f (<4>3P)4G
-	106014.0	-	19% 3d4 4f (<4>1F)2G	+ 18% 3d4 4f (<4>3D)4F
-	106017.0	-	24% 3d4 4f (<4>3D)2G	+ 22% 3d4 4f (<4>1F)2H
-	106075.0	-	17% 3d4 4f (<2>3F)4F	+ 12% 3d4 4f (<2>1G)2G
-	106103.0	-	19% 3d4 4f (<2>3P)4G	+ 11% 3d4 4f (<4>3P)4G
-	106108.0	-	27% 3d4 4f (<4>1F)2H	+ 13% 3d4 4f (<2>3F)4H
-	106122.0	-	17% 3d4 4f (<4>1D)2G	+ 13% 3d4 4f (<2>1G)2H
-	106128.0	-	25% 3d4 4f (<2>1G)2G	+ 8% 3d4 4f (<4>1F)2G
-	106131.0	-	29% 3d4 4f (<2>1G)2H	+ 10% 3d4 4f (<2>3F)2H
-	106163.0	-	34% 3d4 4f (<4>1D)2H	+ 13% 3d4 4f (<2>3P)2G
-	106434.0	-	36% 3d3 4s 4p ((<3>2H)1H)2G	+ 16% 3d3 4s 4p ((<3>2H)3H)2G
-	106502.0	-	15% 3d4 4f (<2>3F)4F	+ 12% 3d4 4f (<4>1G)2G
-	106567.0	-	13% 3d4 4f (<4>1G)2H	+ 11% 3d4 4f (<2>3F)2G

	-	106616.0	-	24% 3d4 4f (<2>1D)2G + 8% 3d4 4f (<4>3P)4F
	-	106631.0	-	25% 3d4 4f (<2>1D)2H + 12% 3d4 4f (<4>3D)4H
	107739.0	107323.0	416.0	40% 3d3 4s 4p ((<3>4F)5F)4G + 22% 3d3 4s 4p ((<3>4F)3F)4G
	-	109336.0	-	50% 3d3 4s 4p ((<3>4F)5F)4F + 32% 3d3 4s 4p ((<3>4F)3F)4F
	-	113908.0	-	92% 3d3 4s 4p ((<3>2F)3F)4F
	-	115960.0	-	93% 3d3 4s 4p ((<3>2F)3F)4G + 5% 3d3 4s 4p ((<3>2H)3H)4G
	-	119659.0	-	71% 3d3 4s 4p ((<3>2G)3G)2H + 19% 3d3 4s 4p ((<3>2G)1G)2H
	-	120152.0	-	31% 3d3 4s 4p ((<3>2G)3G)2G + 27% 3d3 4s 4p ((<3>2F)1F)2G
	-	120212.0	-	35% 3d3 4s 4p ((<3>2F)1F)2G + 34% 3d3 4s 4p ((<3>2G)3G)2G
	-	122835.0	-	67% 3d3 4s 4p ((<3>2H)3H)2H + 23% 3d3 4s 4p ((<3>2H)1H)2H
	-	128187.0	-	60% 3d3 4s 4p ((<3>2H)3H)2G + 24% 3d3 4s 4p ((<3>2H)1H)2G
	-	133959.0	-	76% 3d3 4s 4p ((<1>2D)3D)4F + 22% 3d3 4s 4p ((<3>2D)3D)4F
	-	138625.0	-	66% 3d3 4s 4p ((<3>2F)3F)2G + 24% 3d3 4s 4p ((<3>2F)1F)2G
11/2	47752.0	48164.0	-412.0	100% 3d4 4p (<4>5D)6F
	63849.0	63099.0	750.0	87% 3d4 4p (<4>3H)4H + 11% 3d4 4p (<4>3G)4H
	65420.0	64570.0	850.0	98% 3d4 4p (<4>3H)4I
	65710.0	65424.0	286.0	69% 3d4 4p (<4>3H)4G + 17% 3d4 4p (<4>3G)4G
	67369.0	66577.0	792.0	40% 3d4 4p (<4>3F)4G + 30% 3d4 4p (<4>3H)2I
	67506.0	66656.0	850.0	63% 3d4 4p (<4>3H)2I + 21% 3d4 4p (<4>3F)4G
	68738.0	67534.0	1204.0	90% 3d4 4p (<4>3H)2H
	69170.0	68958.0	212.0	88% 3d4 4p (<4>3G)4H + 10% 3d4 4p (<4>3H)4H
	70399.0	70035.0	364.0	66% 3d4 4p (<4>3G)4G + 13% 3d4 4p (<4>3G)2H
	70880.0	70616.0	264.0	67% 3d4 4p (<4>3G)2H + 13% 3d4 4p (<4>1I)2H
	-	72469.0	-	94% 3d4 4p (<4>1I)2I + 5% 3d4 4p (<4>3H)2I
	74707.0	74372.0	335.0	42% 3d4 4p (<4>1G)2H + 24% 3d4 4p (<4>1I)2H
	-	75217.0	-	56% 3d4 4p (<4>1I)2H + 18% 3d4 4p (<4>1G)2H
	-	80183.0	-	100% 3d3 4s 4p ((<3>4F)5F)6G
	82613.0	82816.0	-203.0	99% 3d3 4s 4p ((<3>4F)5F)6F
	87450.0	87370.0	80.0	59% 3d3 4s 4p ((<3>4F)3F)4G + 36% 3d3 4s 4p ((<3>4F)5F)4G
	91292.0	91707.0	-415.0	75% 3d4 4p (<2>3F)4G + 22% 3d4 4p (<4>3F)4G
	-	95755.0	-	74% 3d3 4s 4p ((<3>2G)3G)4H + 22% 3d3 4s 4p ((<3>2H)3H)4H
	97494.0	96765.0	729.0	84% 3d3 4s 4p ((<3>2G)3G)4G + 6% 3d3 4s 4p ((<3>4F)3F)4G
	97899.0	97190.0	709.0	57% 3d4 4p (<2>1G)2H + 29% 3d4 4p (<4>1G)2H
	-	100007.0	-	76% 3d3 4s 4p ((<3>2H)3H)4H + 22% 3d3 4s 4p ((<3>2G)3G)4H
	101783.0	101131.0	652.0	49% 3d3 4s 4p ((<3>2G)1G)2H + 19% 3d3 4s 4p ((<3>2G)3G)2H
	101932.0	101803.0	129.0	82% 3d3 4s 4p ((<3>2H)3H)4I + 9% 3d3 4s 4p ((<3>2G)1G)2H
	-	103723.0	-	63% 3d3 4s 4p ((<3>2H)1H)2H + 16% 3d3 4s 4p ((<3>2H)3H)2H
	-	104473.0	-	37% 3d3 4s 4p ((<3>2H)3H)4G + 15% 3d4 4f (<4>5D)4G
	-	104726.0	-	17% 3d4 4f (<2>1G)2I + 16% 3d4 4f (<4>3H)4K
	-	104743.0	-	10% 3d4 4f (<2>1G)2H + 8% 3d4 4f (<4>3F)4G
	-	104758.0	-	11% 3d4 4f (<4>3G)4K + 10% 3d4 4f (<4>3D)2H
	-	104772.0	-	10% 3d4 4f (<4>3D)4H + 10% 3d4 4f (<4>5D)6H
	-	104785.0	-	13% 3d4 4f (<2>3F)4H + 9% 3d4 4f (<4>3G)4I
	-	105137.0	-	22% 3d4 4f (<4>5D)4G + 13% 3d3 4s 4p ((<3>2H)3H)4G
	-	105225.0	-	22% 3d4 4f (<4>1I)2I + 16% 3d4 4f (<4>3H)2H
	105368.0	105253.0	115.0	25% 3d4 4f (<4>5D)6H + 13% 3d4 4f (<4>5D)6G
	-	105271.0	-	17% 3d4 4f (<4>5D)4H + 10% 3d4 4f (<4>3H)2I
	-	105283.0	-	14% 3d4 4f (<4>5D)6H + 13% 3d4 4f (<4>3H)2I
	105560.0	105288.0	272.0	15% 3d4 4f (<4>5D)4H + 14% 3d4 4f (<4>5D)6F
	-	105311.0	-	35% 3d4 4f (<4>3H)4I + 13% 3d4 4f (<4>3G)2H
	-	105325.0	-	25% 3d4 4f (<4>3H)4H + 20% 3d4 4f (<4>3G)4G
	-	105359.0	-	17% 3d4 4f (<4>3F)2I + 14% 3d4 4f (<4>3G)4K
	-	105365.0	-	23% 3d4 4f (<4>3F)4I + 14% 3d4 4f (<4>3G)2I
	-	105375.0	-	29% 3d4 4f (<4>3G)4I + 24% 3d4 4f (<4>1G)2I
	-	105381.0	-	17% 3d4 4f (<4>3P)4G + 8% 3d4 4f (<4>3D)4H
	-	105397.0	-	30% 3d4 4f (<4>1G)2H + 21% 3d4 4f (<4>3G)4H
	-	105445.0	-	36% 3d4 4f (<4>1I)2H + 21% 3d4 4f (<4>3H)4G
	-	105462.0	-	25% 3d4 4f (<2>3F)2I + 18% 3d4 4f (<2>3P)4G
	-	105482.0	-	17% 3d4 4f (<4>3F)2H + 16% 3d4 4f (<4>1G)2I
	-	105519.0	-	26% 3d4 4f (<2>3F)4G + 19% 3d4 4f (<4>3F)4G
	-	105603.0	-	35% 3d4 4f (<2>1D)2H + 14% 3d4 4f (<4>3P)4G
	-	105647.0	-	15% 3d4 4f (<4>3H)2H + 12% 3d3 4s 4p ((<3>2H)1H)2I
	-	105750.0	-	10% 3d4 4f (<2>3F)2H + 10% 3d4 4f (<4>3F)4I
	105898.0	105866.0	32.0	13% 3d4 4f (<4>5D)6F + 10% 3d4 4f (<4>5D)6G
	-	105883.0	-	17% 3d4 4f (<4>5D)6H + 11% 3d4 4f (<4>3F)4I
	-	105888.0	-	16% 3d4 4f (<4>3F)4H + 12% 3d4 4f (<4>5D)4H
	-	105923.0	-	24% 3d4 4f (<4>3H)4H + 24% 3d4 4f (<4>3G)4G
	-	105934.0	-	21% 3d4 4f (<4>3G)4H + 16% 3d4 4f (<4>3G)2H
	-	105960.0	-	8% 3d4 4f (<4>3F)2I + 7% 3d4 4f (<4>1I)2I
	-	105984.0	-	15% 3d4 4f (<4>1F)2I + 9% 3d4 4f (<4>3F)4I
	-	105996.0	-	38% 3d4 4f (<4>3H)4G + 33% 3d4 4f (<4>1I)2H
	-	106003.0	-	22% 3d4 4f (<4>3D)4G + 16% 3d4 4f (<4>1F)2H
	-	106030.0	-	21% 3d4 4f (<2>3F)4I + 13% 3d4 4f (<4>3D)2H
	-	106098.0	-	16% 3d4 4f (<2>1G)2I + 15% 3d4 4f (<4>1F)2I
	-	106105.0	-	28% 3d4 4f (<4>1F)2H + 11% 3d4 4f (<2>3F)4I
	-	106108.0	-	42% 3d4 4f (<2>1G)2H + 9% 3d4 4f (<2>3F)4H
	-	106174.0	-	32% 3d4 4f (<4>1D)2H + 17% 3d4 4f (<2>3P)4G
	-	106403.0	-	10% 3d4 4f (<2>1G)2I + 10% 3d3 4s 4p ((<3>2H)1H)2I
	-	106477.0	-	22% 3d3 4s 4p ((<3>2H)1H)2I + 11% 3d4 4f (<4>1G)2I
	-	106568.0	-	12% 3d4 4f (<2>3F)4H + 9% 3d4 4f (<2>3F)4G
	-	106614.0	-	22% 3d4 4f (<2>1D)2H + 13% 3d4 4f (<4>3D)4H
	-	107663.0	-	39% 3d3 4s 4p ((<3>4F)5F)4G + 22% 3d3 4s 4p ((<3>4F)3F)4G
	-	116027.0	-	94% 3d3 4s 4p ((<3>2F)3F)4G + 5% 3d3 4s 4p ((<3>2H)3H)4G
	-	120019.0	-	71% 3d3 4s 4p ((<3>2G)3G)2H + 21% 3d3 4s 4p ((<3>2G)1G)2H
	-	123009.0	-	69% 3d3 4s 4p ((<3>2H)3H)2H + 24% 3d3 4s 4p ((<3>2H)1H)2H

	-	124448.0	-	73% 3d3 4s 4p ((<3>2H)3H)2I + 24% 3d3 4s 4p ((<3>2H)1H)2I
13/2	64031.0	63264.0	767.0	88% 3d4 4p (<4>3H)4H + 10% 3d4 4p (<4>3G)4H
	65618.0	64752.0	866.0	99% 3d4 4p (<4>3H)4I
	67589.0	66754.0	835.0	94% 3d4 4p (<4>3H)2I + 4% 3d4 4p (<4>1I)2I
	69388.0	69154.0	234.0	89% 3d4 4p (<4>3G)4H + 10% 3d4 4p (<4>3H)4H
	-	72478.0	-	93% 3d4 4p (<4>1I)2I + 5% 3d4 4p (<4>3H)2I
	74424.0	73196.0	1228.0	98% 3d4 4p (<4>1I)2K
	-	80552.0	-	100% 3d3 4s 4p ((<3>4F)5F)6G
	-	96078.0	-	76% 3d3 4s 4p ((<3>2G)3G)4H + 23% 3d3 4s 4p ((<3>2H)3H)4H
	-	100127.0	-	76% 3d3 4s 4p ((<3>2H)3H)4H + 23% 3d3 4s 4p ((<3>2G)3G)4H
	101901.0	101904.0	-3.0	98% 3d3 4s 4p ((<3>2H)3H)4I
	-	104720.0	-	23% 3d4 4f (<2>1G)2I + 17% 3d4 4f (<4>3F)4H
	105896.0	104725.0	1171.0	22% 3d4 4f (<4>3H)4L + 21% 3d4 4f (<2>1G)2K
	-	104764.0	-	18% 3d4 4f (<2>3F)4I + 18% 3d4 4f (<4>3D)4H
	-	105204.0	-	20% 3d4 4f (<4>1I)2I + 17% 3d4 4f (<4>3H)2I
	-	105270.0	-	37% 3d4 4f (<4>3H)4L + 26% 3d4 4f (<4>5D)4H
	105508.0	105274.0	234.0	26% 3d4 4f (<4>5D)6H + 18% 3d4 4f (<4>3H)2K
	-	105293.0	-	19% 3d4 4f (<4>5D)6G + 13% 3d4 4f (<4>3H)4K
	-	105311.0	-	20% 3d4 4f (<4>1I)2I + 19% 3d4 4f (<4>3H)4K
	-	105322.0	-	18% 3d4 4f (<4>3G)4H + 15% 3d4 4f (<4>3H)4H
	-	105334.0	-	38% 3d4 4f (<4>1I)2K + 34% 3d4 4f (<4>3H)4I
	-	105365.0	-	18% 3d4 4f (<4>3G)4K + 17% 3d4 4f (<4>3F)4I
	-	105372.0	-	24% 3d4 4f (<4>1G)2K + 19% 3d4 4f (<4>3G)4K
	-	105379.0	-	29% 3d4 4f (<4>1G)2I + 25% 3d4 4f (<4>3G)4I
	-	105486.0	-	21% 3d4 4f (<2>3F)4H + 16% 3d4 4f (<4>3F)4H
	-	105500.0	-	14% 3d4 4f (<4>1G)2K + 13% 3d4 4f (<2>3F)4I
	-	105834.0	-	27% 3d4 4f (<4>3H)4H + 12% 3d3 4s 4p ((<3>2H)1H)2I
	105743.0	105875.0	-132.0	33% 3d4 4f (<4>5D)4H + 22% 3d4 4f (<4>3H)4L
	-	105880.0	-	26% 3d4 4f (<4>5D)6G + 16% 3d4 4f (<4>1G)2I
	-	105888.0	-	20% 3d4 4f (<4>3F)4I + 14% 3d4 4f (<4>5D)6H
	-	105918.0	-	18% 3d4 4f (<4>3H)2I + 16% 3d4 4f (<4>1I)2K
	-	105934.0	-	29% 3d4 4f (<4>3G)2I + 23% 3d4 4f (<4>3H)2I
	-	105951.0	-	40% 3d4 4f (<4>3G)4H + 30% 3d4 4f (<4>3H)4I
	-	105987.0	-	25% 3d4 4f (<4>1F)2I + 25% 3d4 4f (<4>3D)4H
	-	106059.0	-	29% 3d4 4f (<2>1G)2I + 15% 3d4 4f (<2>3F)4I
	-	106100.0	-	30% 3d4 4f (<2>1G)2K + 15% 3d4 4f (<2>3F)2I
	-	106106.0	-	24% 3d4 4f (<2>1G)2K + 19% 3d4 4f (<2>3F)4I
	-	106451.0	-	37% 3d3 4s 4p ((<3>2H)1H)2I + 14% 3d3 4s 4p ((<3>2H)3H)2I
	-	106546.0	-	22% 3d4 4f (<2>3F)2I + 14% 3d4 4f (<4>1G)2K
	-	106573.0	-	22% 3d4 4f (<2>3F)4H + 12% 3d4 4f (<2>1G)2I
	-	124700.0	-	73% 3d3 4s 4p ((<3>2H)3H)2I + 26% 3d3 4s 4p ((<3>2H)1H)2I
15/2	65813.0	64940.0	873.0	100% 3d4 4p (<4>3H)4I
	-	73431.0	-	100% 3d4 4p (<4>1I)2K
	-	102135.0	-	98% 3d3 4s 4p ((<3>2H)3H)4I
	-	104725.0	-	21% 3d4 4f (<2>1G)2K + 20% 3d4 4f (<4>3F)4I
	-	105270.0	-	33% 3d4 4f (<4>5D)6H + 24% 3d4 4f (<4>3H)2L
	-	105309.0	-	39% 3d4 4f (<4>3H)4L + 24% 3d4 4f (<4>3G)2K
	-	105319.0	-	44% 3d4 4f (<4>3H)4K + 24% 3d4 4f (<4>3G)4I
	-	105333.0	-	55% 3d4 4f (<4>1I)2L + 31% 3d4 4f (<4>3H)2K
	-	105348.0	-	47% 3d4 4f (<4>1I)2K + 42% 3d4 4f (<4>3H)4I
	-	105377.0	-	38% 3d4 4f (<4>1G)2K + 30% 3d4 4f (<4>3G)4K
	-	105521.0	-	37% 3d4 4f (<2>3F)4I + 27% 3d4 4f (<4>3F)4I
	105682.0	105876.0	-194.0	41% 3d4 4f (<4>5D)6H + 16% 3d4 4f (<4>1G)2K
	-	105931.0	-	47% 3d4 4f (<4>3G)2K + 20% 3d4 4f (<4>3H)4L
	-	105936.0	-	43% 3d4 4f (<4>3G)4I + 22% 3d4 4f (<4>3H)4K
	-	105936.0	-	42% 3d4 4f (<4>3H)2K + 37% 3d4 4f (<4>1I)2L
	-	105952.0	-	37% 3d4 4f (<4>1I)2K + 35% 3d4 4f (<4>3H)4I
	-	106112.0	-	54% 3d4 4f (<2>1G)2K + 15% 3d4 4f (<4>3F)4I
	-	106546.0	-	32% 3d4 4f (<2>3F)4I + 14% 3d4 4f (<4>1G)2K
17/2	-	105310.0	-	44% 3d4 4f (<4>3H)4L + 34% 3d4 4f (<4>3G)4K
	-	105333.0	-	50% 3d4 4f (<4>1I)2M + 25% 3d4 4f (<4>3H)2L
	-	105333.0	-	50% 3d4 4f (<4>1I)2L + 38% 3d4 4f (<4>3H)4K
	-	105931.0	-	66% 3d4 4f (<4>3G)4K + 22% 3d4 4f (<4>3H)4L
	-	105936.0	-	40% 3d4 4f (<4>1I)2M + 31% 3d4 4f (<4>3H)2L
	-	105936.0	-	46% 3d4 4f (<4>3H)4K + 40% 3d4 4f (<4>1I)2L
19/2	-	105333.0	-	55% 3d4 4f (<4>1I)2M + 45% 3d4 4f (<4>3H)4L
	-	105936.0	-	55% 3d4 4f (<4>3H)4L + 45% 3d4 4f (<4>1I)2M

Table V. **HF and LSF parameters of even configurations of Cr I in cm^{-1} :**

1 system 1 sigma(3)= 471.00 CONVERGED.

configuration	parameter	LSF	accuracy	HF	LSF/HF
3d5 4s	E0(3d5 4s)	34599.0	93.0	39170.0	0.883
	F2(3d, 3d)	47530.0	468.0	65470.5	0.726
	F4(3d, 3d)	29212.7	287.0	40239.2	0.726
	alfa(3d)	50.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	200.8	(fixed)	200.9	1.000
	G2(3d, 4s)	7012.7	(fixed)	9350.3	0.750
3d4 4s2	E0(3d4 4s2)	31235.9	186.0	30961.6	1.008
	F2(3d, 3d)	59309.5	811.0	74651.8	0.794
	F4(3d, 3d)	36772.0	503.0	46284.3	0.794
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	235.0	(fixed)	235.0	1.000
3d5 4d	E0(3d5 4d)	77241.0	447.0	77270.8	1.119
	F2(3d, 3d)	50968.5	1289.0	67629.2	0.754
	F4(3d, 3d)	34882.0	882.0	41661.7	0.837
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	205.5	(fixed)	205.5	1.000
	zeta(4d)	2.7	(fixed)	2.8	0.964
	F1(3d, 4d)	0.0	(fixed)	0.0	
	F2(3d, 4d)	0.0	148909.0	1734.6	0.000
	F3(3d, 4d)	0.0	(fixed)	0.0	
	F4(3d, 4d)	0.0	148909.0	645.9	0.000
	G0(3d, 4d)	1407.9	1013.0	1275.8	1.104
	G1(3d, 4d)	0.0	(fixed)	0.0	
	G2(3d, 4d)	858.1	617.0	777.5	1.104
	G3(3d, 4d)	0.0	(fixed)	0.0	
	G4(3d, 4d)	561.3	404.0	508.8	1.103
3d5 4s -3d4 4s2	R2(3d, 3d; 3d, 4s)	-5907.1	(fixed)	-7383.9	0.800
3d5 4s -3d5 4d	R2(3d, 4s; 3d, 4d)	1086.1	(fixed)	1357.7	0.800
	R2(3d, 4s; 4d, 3d)	54.2	(fixed)	67.7	0.801
3d4 4s2 -3d5 4d	R2(4s, 4s; 3d, 4d)	-941.3	(fixed)	-1176.6	0.800

Table VI. HF and LSF parameters of odd configurations of Cr I in cm^{-1}:

1 system 2 sigma(5)= 456.00 CONVERGED

configuration	parameter	LSF	accuracy	HF	LSF/HF
3d5 4p	E0(3d5 4p)	58994.4	59.0	60645.6	1.136
	F2(3d, 3d)	53413.0	(fixed)	66767.6	0.800
	F4(3d, 3d)	32875.2	(fixed)	41094.2	0.800
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	203.8	(fixed)	203.8	1.000
	zeta(4p)	86.8	(fixed)	86.8	1.000
	F1(3d, 4p)	0.0	(fixed)	0.0	
	F2(3d, 4p)	6810.3	(fixed)	8513.0	0.800
	G1(3d, 4p)	2997.8	(fixed)	3997.1	0.750
	G2(3d, 4p)	0.0	(fixed)	0.0	
	G3(3d, 4p)	2151.4	(fixed)	2868.6	0.750
	3d4 4s 4p:				
	E0(3d4 4s 4p)	56893.9	44.0	51416.7	1.820
	F2(3d, 3d)	60329.9	(fixed)	75412.5	0.800
	F4(3d, 3d)	37434.3	(fixed)	46793.0	0.800
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	237.1	(fixed)	237.1	1.000
	zeta(4p)	147.3	(fixed)	147.4	0.999
	F1(3d, 4p)	0.0	(fixed)	0.0	
	F2(3d, 4p)	8418.8	(fixed)	10523.6	0.800
	G2(3d, 4s)	6895.7	(fixed)	9194.3	0.750
	G1(3d, 4p)	3201.6	(fixed)	4268.8	0.750
	G2(3d, 4p)	0.0	(fixed)	0.0	
	G3(3d, 4p)	2496.5	(fixed)	3328.7	0.750
	G1(4s, 4p)	23313.0	(fixed)	31084.1	0.750
	3d5 4p -3d4 4s 4p:				
	R2(3d, 3d; 3d, 4s)	-4294.2	-119.0	-7343.2	0.585
	R2(3d, 4p; 4s, 4p)	-5886.6	-163.0	-10066.4	0.585
	R1(3d, 4p; 4p, 4s)	-6174.2	-171.0	-10558.3	0.585

Table VII. HF and LSF parameters of even configurations of Cr II in cm^{-1} :

1 system 1 sigma(3)= 428.00 CONVERGED.

configuration	parameter	LSF	accuracy	HF	LSF/HF
3d5	E0(3d5)	34656.9	92.0	36935.0	
	F2(3d, 3d)	52394.2	399.0	67741.4	0.773
	F4(3d, 3d)	32279.9	246.0	41735.3	0.773
	alfa(3d)	41.8	(fixed)		
	beta(3d)	439.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	205.9	(fixed)	205.9	1.000
3d4 4s	E0(3d4 4s)	38913.4	64.0	35365.8	-2.712
	F2(3d, 3d)	59718.1	276.0	76058.2	0.785
	F4(3d, 3d)	37077.9	171.0	47223.2	0.785
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	238.8	(fixed)	238.8	1.000
	G2(3d, 4s)	7801.9	(fixed)	10402.6	0.750
3d4 4d	E0(3d4 4d)	113809.4	82.0	107254.7	1.126
	F2(3d, 3d)	61062.3	282.0	77770.4	0.785
	F4(3d, 3d)	44050.3	420.0	48372.6	0.911
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	243.5	(fixed)	243.6	1.000
	zeta(4d)	10.9	(fixed)	10.9	1.000
	F1(3d, 4d)	0.0	(fixed)	0.0	
	F2(3d, 4d)	4499.7	21.0	5731.0	0.785
	F3(3d, 4d)	0.0	(fixed)	0.0	
	F4(3d, 4d)	2158.7	21.0	2370.5	0.911
	G0(3d, 4d)	2570.0	(fixed)	3427.7	0.750
	G1(3d, 4d)	0.0	(fixed)	0.0	
	G2(3d, 4d)	1899.0	(fixed)	2532.0	0.750
	G3(3d, 4d)	0.0	(fixed)	0.0	
	G4(3d, 4d)	1304.0	(fixed)	1738.6	0.750
3d5 -3d4 4s	R2(3d, 3d; 3d, 4s)	-6125.2	(fixed)	-7656.5	0.800
3d5 -3d4 4d	R0(3d, 3d; 3d, 4d)	1264.9	(fixed)	1581.2	0.800
	R2(3d, 3d; 3d, 4d)	8236.4	(fixed)	10295.5	0.800
	R4(3d, 3d; 3d, 4d)	5471.1	(fixed)	6838.9	0.800
3d4 4s -3d4 4d	R2(3d, 4s; 3d, 4d)	4580.3	(fixed)	5725.4	0.800
	R2(3d, 4s; 4d, 3d)	1293.0	(fixed)	1616.2	0.800

Table-VIII. HF and LSF parameters of odd configurations of Cr II in cm^{-1}:

1 system 2 sigma(5)= 458.00 CONVERGED.

configuration	parameter	LSF	accuracy	HF	LSF/HF
3d4 4p	E0(3d4 4p)	74284.2	37.0	69110.0	1.232
	F2(3d, 3d)	61230.3	177.0	76850.0	0.797
	F4(3d, 3d)	38048.4	110.0	47754.5	0.797
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	241.1	(fixed)	241.2	1.000
	zeta(4p)	237.8	(fixed)	237.9	1.000
	F1(3d, 4p)	0.0	(fixed)	0.0	
	F2(3d, 4p)	12271.2	253.0	14315.0	0.857
	G1(3d, 4p)	4514.6	93.0	5968.9	0.756
	G2(3d, 4p)	0.0	(fixed)	0.0	
	G3(3d, 4p)	3640.8	75.0	4813.6	0.756
3d3 4s 4p	E0(3d3 4s 4p)	107240.2	77.0	98025.8	1.188
	F2(3d, 3d)	66490.3	504.0	84385.0	0.788
	F4(3d, 3d)	41577.1	315.0	52766.9	0.788
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	276.0	(fixed)	276.1	1.000
	zeta(4p)	321.1	(fixed)	321.2	1.000
	F1(3d, 4p)	0.0	(fixed)	0.0	
	F2(3d, 4p)	16125.1	488.0	16020.6	1.007
	G2(3d, 4s)	7496.2	(fixed)	9995.0	0.750
	G1(3d, 4p)	5337.1	162.0	6009.5	0.888
	G2(3d, 4p)	0.0	(fixed)	0.0	
	G3(3d, 4p)	4553.2	138.0	5126.8	0.888
	G1(4s, 4p)	31328.1	(fixed)	41770.9	0.750
3d4 4f	E0(3d4 4f)	105608.4	100.0	124450.5	0.811
	F2(3d, 3d)	483.7	487.0	78038.4	0.006
	F4(3d, 3d)	300.9	303.0	48550.3	0.006
	alfa(3d)	0.0	(fixed)		
	beta(3d)	0.0	(fixed)		
	T(3d)	0.0	(fixed)		
	T1(3d)	0.0	(fixed)	0.0	
	T2(3d)	0.0	(fixed)	0.0	
	zeta(3d)	244.7	(fixed)	244.8	1.000
	zeta(4f)	0.1	(fixed)	0.1	1.000
	F1(3d, 4f)	0.0	(fixed)	0.0	
	F2(3d, 4f)	0.1	(fixed)	1352.8	0.000
	F3(3d, 4f)	0.0	(fixed)	0.0	
	F4(3d, 4f)	0.0	(fixed)	246.5	0.000
	G1(3d, 4f)	0.0	(fixed)	160.6	0.000
	G2(3d, 4f)	0.0	(fixed)	0.0	
	G3(3d, 4f)	0.0	(fixed)	91.8	0.000
	G4(3d, 4f)	0.0	(fixed)	0.0	
	G5(3d, 4f)	0.0	(fixed)	62.9	0.000
3d4 4p -3d3 4s 4p	R2(3d, 3d; 3d, 4s)	-3864.3	(fixed)	-4830.4	0.800
	R2(3d, 4p; 4s, 4p)	-10511.5	(fixed)	-13139.4	0.800
	R1(3d, 4p; 4p, 4s)	-10847.5	(fixed)	-13559.4	0.800
3d4 4p -3d4 4f	R2(3d, 4p; 3d, 4f)	2107.7	(fixed)	2634.7	0.800
	R4(3d, 4p; 3d, 4f)	688.5	(fixed)	860.6	0.800
	R1(3d, 4p; 4f, 3d)	626.9	(fixed)	783.6	0.800
	R3(3d, 4p; 4f, 3d)	414.0	(fixed)	517.4	0.800
3d3 4s 4p -3d4 4f	R2(4s, 4p; 3d, 4f)	-2413.9	(fixed)	-3017.3	0.800
	R3(4s, 4p; 4f, 3d)	-1386.8	(fixed)	-1733.5	0.800

Table-IX-Observed wavelengths and energy levels of Cr I

Observed Wavelength (λ) (Å) in air	Observed Wave number (σ) (cm^{-1}) in vacuum	Classification		Energy Levels of Lower state (cm^{-1}) Ref. [12]	Energy Levels of Upper state (cm^{-1}) Ref. [12]	Observed Energy levels- (cm^{-1}) in the present work
		Configurations Lower Ref. [12]	Configurations Upper Ref. [12]			
5480.4999	18241.476	$3d^4 4s^2\ b^3G_5$	$3d^5\ (^4G)4p\ y^3F_4^o$	27816.88	46058.20	46058.356
5423.1410	18434.378	$3d^5\ (^2F_2)4s\ d^3F_2$	$3d^5\ (a^2D)4p\ v^3F_2^o$	36558.55	54992.93	54992.928
5409.7618	18479.971	$3d^4 4s^2\ a^5D_4$	$3d^5\ (^6S)4p\ z^5P_3$	8307.57	26787.50	26787.541
5405.1824	18495.630	$3d^5(^2H)\ 4s\ a^1H_5$	$3d^4\ (a^3F)4s4p(^1P^o)\ u^3G_4^o$	38537.68	57033.60	57033.31
5400.6908	18511.007	$3d^5\ (^4P)4s\ b^3P_2$	$3d^5\ (^4P)4p\ y^3P_2^o$	27223.05	45734.32	45734.057
5390.3856	18546.412	$3d^5\ (^4P)4s\ b^3P_1$	$3d^5\ (^4P)4p\ y^3P_0^o$	27176.22	45722.59	45722.632
5387.5846	18556.050	$3d^5\ (^4P)4s\ b^3P_0$	$3d^5\ (^4P)4p\ y^3P_1^o$	27163.20	45719.20	45719.250
5386.9502	18558.220	$3d^5\ (^4P)4s\ b^3P_1$	$3d^5\ (^4P)4p\ y^3P_2^o$	27176.22	45734.32	45734.440
5362.9239	18641.374	$3d^5\ (^2D_3)4s\ b^3D_3$	$3d^5\ (^4D)4p\ x^3F_3^o$	31009.00	49650.22	49650.374
5354.3127	18671.350	$3d^5\ (^2G_2)4s\ c^3G_4$	$3d^4\ (^1I)4s4p(^3P^o)\ u^3H_4^o$	37244.17	55915.50	55915.520
5348.3317	18692.227	$3d^4 4s^2\ a^5D_3$	$3d^5\ (^6S)4p\ z^5P_3^o$	8095.21	26787.50	26787.437
5345.8965	18700.758	$3d^4\ 4s^2\ a^5D_3$	$3d^5\ (^6S)4p\ z^5P_2^o$	8095.21	26796.28	26795.968
5329.1272	18759.606	$3d^5(^6S)4p\ z^7P_4^o$	$3d^5\ (^6S)4d\ e^7D_4$	23498.84	42258.37	42258.446
5328.3781	18762.247	$3d^5\ (^6S)4p\ z^7P_4^o$	$3d^5\ (^6S)4d\ e^7D_5$	23498.84	42261.06	42261.087
5308.7233	18831.644	$3d^5\ (^4F)4s\ a^5F_1$	$3d^5\ (^4D)4p\ w^3D_2^o$	31352.42	50184.10	50184.114
5300.7005	18860.186	$3d^4 4s^2\ a^5D_2$	$3d^5\ (^6S)4p\ z^5P_3$	7927.47	26787.50	26787.056
5298.2768	18868.836	$3d^4\ 4s^2\ a^5D_2$	$3d^5(^6S)4p\ z^5P_2$	7927.47	26796.28	26796.306
5265.7573	18985.364	$3d^4\ 4s^2\ a^5D_1$	$3d^5(^6S)4p\ z^5P_2^o$	7810.82	26796.28	26796.184
5264.1517	18991.134	$3d^4\ 4s^2\ a^5D_1$	$3d^5(^6S)4p\ z^5P_1^o$	7810.82	26801.93	26801.954
5208.4094	19194.410	$3d^5(^6S)4s\ a^5S_2$	$3d^5(^6S)4p\ z^5P_3^o$	7593.16	26787.50	26787.570
5206.0360	19203.148	$3d^5(^6S)4s\ a^5S_2$	$3d^5(^6S)4p\ z^5P_2^o$	7593.16	26796.28	26796.308
5204.5180	19208.756	$3d^5(^6S)4s\ a^5S_2$	$3d^5(^6S)4p\ z^5P_1^o$	7593.16	26801.93	26801.916
5196.6058	19237.995	$3d^4\ 4s^2\ b^3G_5$	$3d^5(^4G)4p\ y^3G_4^o$	27816.88	47054.91	47054.875
5154.9225	19393.541	$3d^5(^4F)4s\ c^3F_3$	$3d^5(a^2D)4p\ v^3F_4^o$	35813.73	55207.40	55207.271
5144.6313	19432.330	$3d^5(^4P)4s\ a^5P_1$	$3d^4(^5D)4s4p(^1P^o)\ y^5D_1^o$	21856.94	41289.17	41289.27
5102.5278	19592.699	$3d^4\ 4s^2\ b^3G_3$	$3d^4(^3H)4s4p(^3P^o)\ x^5G_4^o$	27597.22	47189.87	47189.919
5096.7943	19614.726	$3d^5(^4D)4s\ a^3D_3$	$3d^4(a^3F)4s4p(^3P^o)\ ^3D_3^o$	28637.00	48251.91	48251.726
5087.9860	19648.689	$3d^5(^4D)4s\ a^3D_2$	$3d^4(a^3P)4s4p(^3P^o)\ x^3P_1^o$	28682.18	48331.30	48330.869
5085.6106	19657.846	$3d^5(^2F_2)4s\ d^3F_3$	$3d^5(^4F)4p\ v^5G_3^o$	36552.13	56209.81	56209.976
5074.5776	19700.612	$3d^5(^4G)4s\ a^3G_3$	$3d^4(a^3F)4s4p(^3P^o)\ y^5G_4^o$	24833.86	44534.46	44534.472
5068.3949	19724.633	$3d^4\ 4s^2\ a^5D_3$	$3d^4(^5D)4s4p(^3P^o)\ y^7P_3^o$	8095.21	27820.23	27819.843
5067.7185	19727.280	$3d^5(^4P)4s\ a^5P_2$	$3d^4(^5D)4s4p(^1P^o)\ y^5D_3^o$	21847.88	41575.10	41575.160

5063.9741	19741.849	$3d^5(^2G_2)4s\ c^3G_4$	$3d^4(a^3F)4s4p(^1P^o)\ (*)_3$	37244.17	56985.67	56986.019
5038.5463	19841.487	$3d^5(^2D_3)4s\ b^3D_1$	$3d^4(^3G)4s4p(^3P^o)\ w^3F_2$	31048.85	50890.15	50890.337
5034.2570	19858.395	$3d^5(^4P)4s\ b^3P_0$	$3d^5(^4P)4p\ u^5P_1{}^o$	27163.20	47021.75	47021.595
5032.5555	19865.103	$3d^5(^2H)4s\ b^3H_6$	$3d^5(^2I)4p\ x^3I_7{}^o$	35934.02	55799.10	55799.123
5019.0953	19918.375	$3d^44s^2\ a^5D_1$	$3d^4(^5D)4s4p(^3P^o)\ y^7P_2{}^o$	7810.82	27728.87	27729.195
5013.3176	19941.340	$3d^5(^4P)4s\ a^5P_3$	$3d^4(^5D)4s4p(^1P^o)\ y^5D_4$	21840.84	41782.19	41782.180
5001.1463	19989.865	$3d^5(^2H)4s\ b^3H_5$	$3d^4(^1I)4s4p(^3P^o)\ u^3H_5{}^o$	35884.40	55874.98	55874.265
4962.2909	20146.365	$3d^5(^4G)4p\ z^5G_2{}^o$	$3d^5(^4G)4d\ f^5G_3$	42515.35	62661.96	62661.715
4956.5914	20169.532	$3d^44s^2\ b^3G_5$	$3d^5(^4G)4p\ u^5F_5{}^o$	27816.88	47985.76	47986.412
4951.1998	20191.530	$3d^44s^2\ a^3H_5$	$3d^4(^3H)4s4p(^3P^o)\ z^5I_4{}^o$	24056.11	44246.70	44247.640

Table X- Observed wavelengths and energy levels of Cr II

Observed Wavelength(λ) (Å) in air	Observed Wave-number (σ) cm^{-1} in vacuum	Classification		Energy Levels Lower state (cm^{-1}) Ref.[12]	Energy Levels Upper state (cm^{-1}) Ref.[12]	Observed Energy levels- (cm^{-1}) in the present work
		Configurations of lower energy state Ref. [12]	Configurations of upper energy state Ref[12]			
5447.4491	18352.146	$3d^4(^5D)4d\ e^6G_{9/2}$	$3d^4(^5D)4f\ ^6H_{7/2}{}^o$	86847.03	105197.38	105199.18
5446.7210	18354.573	$3d^5\ a^2D_{5/2}$	$3d^4(^5D)4p\ z^4P_{5/2}{}^o$	31350.90	49706.33	49705.47
5440.1396	18376.806	$3d^4(^1F)4p\ v^2G_{7/2}{}^o$	$3d^44d\ f^4H_{7/2}$	85573.17	103949.27	85573.17
5436.8762	18387.825	$3d^4(^5D)4d\ e^6G_{11/2}$	$3d^4(^5D)4f\ ^6H_{11/2}$	86980.10	105367.93	105367.93
5425.5641	18426.156	$3d^4(^3F)4s\ a^4F_{9/2}$	$3d^4(^5D)4p\ z^6D_{7/2}{}^o$	31219.35	49645.77	49645.506
5420.8299	18442.267	$3d^4(^3P)4s\ b^4P_{3/2}$	$3d^4(^5D)4p\ z^4P_{1/2}{}^o$	30307.44	48749.36	48749.707
5419.3607	18447.236	$3d^4(^3P)4s\ b^4P_{1/2}$	$3d^4(^5D)4p\ z^6P_{3/2}{}^o$	29951.88	48398.95	48399.116
5363.8840	18638.038	$3d^4(^5D)4d\ e^6P_{7/2}$	$3d^4(^5D)4f\ ^6D_{7/2}{}^o$	86782.04	105420.09	105420.08
5357.4124	18660.547	$3d^4(^1F)4s\ d^2F_{5/2}$	$3d^4(a^3P)4p\ ^2D_{3/2}{}^o$	50687.62	69348.18	39348.167
5342.5177	18712.589	$3d^4(^5D)4d\ e^6G_{9/2}$	$3d^4(^5D)4f\ ^4H_{11/2}{}^o$	86847.03	105559.58	105559.58
5333.7785	18743.252	$3d^4(^3G)4s\ e^2G_{9/2}$	$3d^4(a^1D)4p\ v^2F_{7/2}{}^o$	62688.95	81432.29	81432.202
5288.3880	18904.123	$3d^4(^5D)4d\ e^6P_{5/2}$	$3d^4(^5D)4f\ ^6D_{5/2}{}^o$	86691.55	105595.35	105595.67
5198.7173	19230.187	$3d^4(^3F)4s\ d^4F_{5/2}$	$3d^4(a^1G)4p\ x^2F_{7/2}{}^o$	54883.54	74114.39	74113.727
5183.4065	19286.985	$3d^4(^1F)4s\ d^2F_{7/2}$	$3d^4(a^3P)4p\ ^2D_{5/2}{}^o$	50667.24	69954.09	69954.225
5181.2330	19295.063	$3d^5\ d^2D_{5/2}$	$3d^4(a^3P)4p\ z^2P_{3/2}$	47354.44	66649.38	66649.503
5171.3139	19332.076	$3d^4(^5D)4d\ e^6G_{5/2}$	$3d^4(^5D)4f\ ^4F_{7/2}{}^o$	86654.18	105985.63	105986.26
5138.5621	19455.285	$3d^4(^3P)4s\ c^4P_{3/2}$	$3d^4(^3D)4p\ y^2P_{1/2}{}^o$	55398.74	74853.85	74854.025
5076.2061	19694.286	$3d^4(^3P)4s\ c^4P_{5/2}$	$3d^4(^3D)4p\ x^4P_{3/2}{}^o$	55023.10	74717.59	74717.386
5059.6001	19758.900	$3d^4(^3P)4s\ a^2P_{1/2}$	$3d^4(^5D)4p\ z^4D_{1/2}{}^o$	34659.32	54418.02	54418.22
4990.3886	20032.966	$3d^5\ d^2D_{5/2}$	$3d^4(a^3F)4p\ z^2D_{5/2}{}^o$	47354.44	67387.16	67387.406
4959.8062	20156.479	$3d^4(^3G)4p\ y^4H_{11/2}{}^o$	$3d^4(^5D)4d\ e^4G_{9/2}$	69170.39	89325.32	89326.869

REFERENCES

1. W. Miller, Ann. Der Phys. [4] **24**, 105 (1907).
2. R. Richter, Dissertation (Gottingen) (1914).
3. C. C. Kiess and W. F. Meggers, Sci. Papers Bur. Std. **16**, 58 No. 372 (1920).
4. M. A. Catalan, Phil. Trans. Roy. Soc. London [A] **223**, 127 (1922).
5. H. Gieseler, Ann. der Phys. [4] **69**, 147 (1922).
6. C. C. Kiess and H. K. Kiess, Science **56**, 666 (1922).
7. H. Gieseler, Zeit. Phys. **22**, 228 (1924).
8. C. C. Kiess, Bur. Std. J. Research **5**, 775, RP229 (1930).
9. C. C. Keiss, see C. E. Moore, Princeton Univ. Obs. Contr. No. 20, 37-42 (1945).
10. C. C. Kiess, unpublished material (February 1950).
11. C. E. Moore, Atomic Energy Levels AEL, Vol II, Circular 467 August 15, (1952).
12. Sugar and C. Corliss, J. Phys. Chem. Ref. Data, **14**, Suppl. 2, 1985.
13. Cowan, R. D., " The Theory of Atomic Structure and Spectra" (University of California Press, Berkeley, CA 1981) and Cowan Code programs.
14. C. C. Kiess, Bur. Std. J. Research **5**, 778, RP229 (1930).
15. H. N. Russell, J. Opt. Soc. Am. **40**, 619 (1950).
16. C. C. Kiess, J. Research Nat. Bur. Std. **47**, 385, RP2266 (1951).